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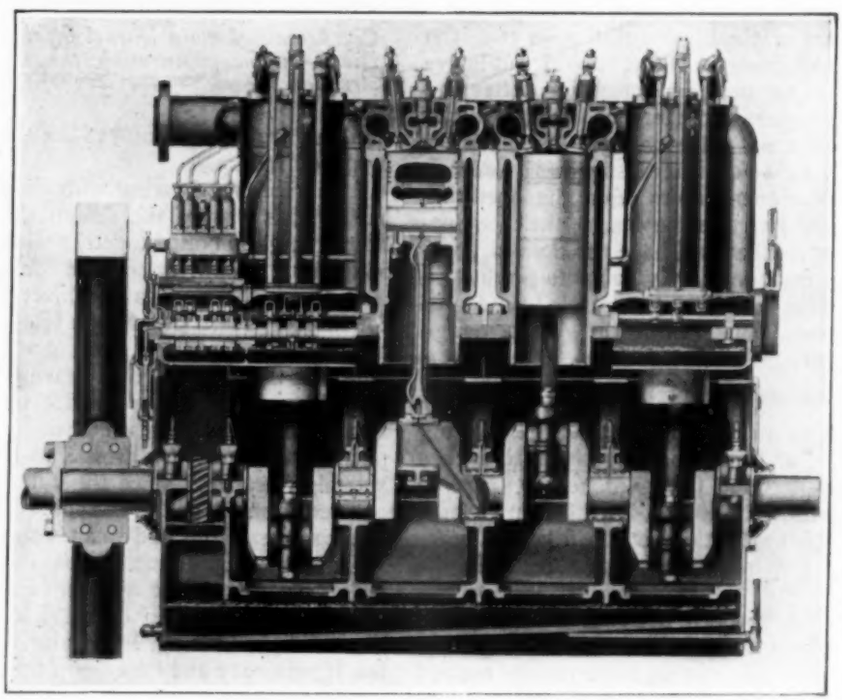
## Factors influencing the design of bearings, gears, drives and lubrication of Diesel engines

# Co-operative Design

By C. E. Cox
*Engineer, Chicago Pneumatic Tool Company*

THE design of so highly stressed a mechanism as the modern Diesel engine is a decidedly complicated undertaking. Each part is affected by conditions that may differ from those affecting other parts and therefore presents its own particular problems, manufacturing as well as engineering. In attacking the job of designing such a unit the designer does not rely solely on his knowledge and experience but calls for the co-operation of the manufacturing and technical departments. The object is to produce a design that is as sound from the economic standpoint as it is from the engineering one. In what follows several of the more important parts of the engine will be discussed to show how a satisfactory result is attained. In selecting the bearings for a Diesel engine the designer is influenced by the following factors: (1) Nature of load to be carried and journal conditions. (2) Space available for the bearing. (3) The frequency of adjustment and replacement and relative skill of mechanic making adjustment. (4) Manufacturing possibilities. (5) Lubrication facilities.



*Sectional view of four-cylinder Diesel engine, showing typical construction and the provisions made for lubricating bearings and other moving parts*

In the Diesel engine more than in any other type it is absolutely necessary that the crankshaft be imbedded in rigidly supported main bearings, carefully aligned, perfectly fitted, and lubricated by the most effective system.

Bending and torsional stresses in the shaft have extremely high instantaneous values and shafts to be of reasonable sizes must receive support over as long a surface as possible.

In the four-cycle Diesel engine of more than one cylinder the stresses in the shaft are complex; and reversals of stresses are frequent. Due to the inertia of the piston as it passes over head-end center before the suction stroke, the pressure on the lower half of the bearing is relieved, a condition very favorable for pressure feed lubrication. Intermittent loads, then, which must be resisted by almost the entire circumference of the bearing constitute the factor that influences the selection of the main bearing. In the multi-cylinder Diesel the bearing must be split, a requirement that precludes the use of roller bearings even on the smaller engines, so that some sliding surface bearing capable of maintaining an oil film must be used. Owing to the many load points of multi-cylinder engines and the desire to keep shafts small there must be many bearings, and the demand for compactness requires that in order to give the

best results the cylinders must be kept close together which limits to a minimum the space required for bearings. A long shaft with many throws is a flexible part and must be supported by a rigid base. Hence it is design practice to make the base a rigid box, deep in section and bridged to support each main bearing. To these bridges the main bearings must be rigidly fixed and in absolute alignment with each other. Attempts to predetermine just how often and who will make adjustments on main bearings are based upon past practice which discloses the fact that bearings must be accessible, must not be too easily adjusted, and must be securely fixed once the adjustment is properly made. The class of mechanics operating Diesels varies widely with respect to skill and the lesser skilled man must be relieved of making exact adjustments—by designing the bearing so that adjustment is infrequent.

To meet these requirements the designer is left small choice, as is evidenced by the almost universal application of one type of bearing for this service, the cylindrical-shell, babbitt-lined bearing. The base and bearing caps are bored very accurately in practically perfect alignment and the bearing shells are machined to fit snugly into these bores, a final scraping process usually being involved in the fitting.

Forged steel shells with machined dovetails for anchoring the babbitt are used. These shells are machined all over, and as a perfect cylinder, are tinned and then babbitted with an alloy of the following composition: Tin, 89 per cent; antimony, 7 per cent; copper, 4 per cent.

The selection of the babbitt is a matter controlled by past practice, experiment and the expert advice of a metallurgist who is constantly in touch with all phases of the pouring of the bearings and their physical qualities after pouring, and finally their behavior in service.

Main bearings were originally designed with cast iron shells and a commercial grade of Diesel babbitt, but heavy duty operation proved the need for something better and the chief engineer-designer, in conference with the metallurgist, chief draftsman, and plant manager—for each has his phase of the question to consider—suggests a bearing. The chief engineer-designer knows what the operating conditions demand and suggests the design, the metallurgist selects the materials that will have the desired properties, and the plant manager finally balances production cost against the benefits possible and controls to a degree the production methods, thus limiting the general design to an economical basis.

### Advantage of Babbitt Bearings

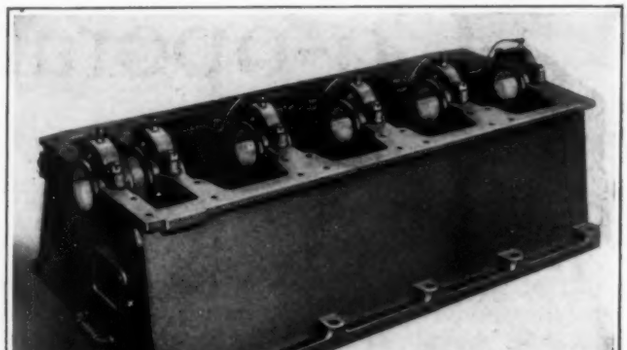
It is not possible to machine the crankshaft, bearing housings in the base, and main bearing shells to such a fine degree that scraping and fitting of bearings can be avoided. For this reason the babbitt-lined bearing adapts itself admirably to this application both in fitting of bearings in the factory and in making replacements in the field.

Every effort of the modern designer tends toward inclosed bearings and copious lubrication.

Pressure feed lubrication is being more rapidly applied and this affects the selection of the type of bearing to be used. The split-shell type assembled with spacers of solid or laminated shims is the most suitable design. Maintaining an oil film is of course the function of any bearing and the method of applying the oil and its distribution over the surface of the bearing and journal are the most important points in bearing design, for a bearing is nothing more than a receptacle for oil of sufficient area and viscosity to withstand the imposed pressure without being squeezed from the receptacle and allowing metal-to-metal contact.

Two-piece babbitt-lined shells solidly bolted together with shims between the halves meet the requirements for good lubrication and accurate adjustment, and are accessible though not too readily adjusted by the novice. The operations involved in adjusting such a bearing breed in him a timidity about taking apart so many vital pieces of an engine. When the adjustment is so convenient as to consist of tightening bolts or screws without even having to go inside the crankcase the novice operator is too prone to adjust bearings too often, but not well.

Practically the same considerations govern the ultimate design of the crankpin bearing as do the main bearings, save that the fittings of each bearing is individual and independent of all the rest. A crank pin bearing is subject to the heavy pressures imposed during the compression and firing stroke and to the alternating stress caused by piston inertia.



*Crankcase and main journal bearings for a four-cylinder Diesel engine, illustrating the sturdiness of the construction needed to take care of the stresses encountered*

A marine-type bearing with boxes of steel, lined with babbitt, has proved the designer's best selection. This bearing, tightly bolted together with shims between halves of the box, is entirely suitable for pressure lubrication.

Pistonpin bearings are subject to different operating conditions. Here the motion is oscillating, pressures are high, heat is high, and the space limited. It is evident then that the selection of a bearing must be made around suitable materials. On small engines the solid-eye connecting rod with a plain bushing of bronze serves its purpose well, for the bronze will sustain high pressure and high heat and since the rubbing velocity and space covered is small, actual metallic contact at short intervals is not so disastrous and wear is slight.

On larger engines an adjustment is desirable and possible because of the greater space afforded, and the marine-type pistonpin bearing, identical in design with the crankpin bearing, is suitable. A heat resisting babbitt is necessary and here again the metallurgist is brought into consultation.

Lubrication for the pistonpin bearing is also most often pressure feed, oil being conducted up the connecting rod by a tube leading from the crankpin box.

Camshafts, while subject to fairly large stresses, present no difficulties with respect to bearings and therefore the only question to be seriously considered is that of general engine design and manufacturing preference.

Loaded in only one direction and operating at low journal speeds the bronze bearing is found most suitable because space for the bearing is limited and this type of bearing is easiest to machine and fit. The square-jaw box is employed and the bearings are solid bronze, simple, easily placed and effective. Lubrication for these bearings is splash and drip. Trouble seldom develops because of the uniformity of the load and the large factors of safety employed in providing areas.

The type of gearing used to transmit the motion of the crankshaft to the camshaft depends upon the distance between the shafts and the angular adjustment required in timing the camshaft. Helical gears have been successfully used, as have spur gears. The former have proved satisfactory but require close alignment of the upper frame with the base, or crankcase, in order to have the gears mesh accurately. On this point the plant manager calls for a redesign if possible with the result that chain gearing is applied giving the advantage of greater leeway in fitting besides furnishing a simple drive not requiring closely held centers. Noiseless operation of gearing is desirable in a Diesel engine in order to heighten the possibility of detecting unusual noises in operation that foretell trouble.

In selecting the type and size of chain gearing to be used various manufacturers are consulted and furnished with operating data. Upon their recommendation the design is completed and usually reviewed by the manufacturer who is recognized as a specialist in that particular line.

Diesel engine lubrication presents some fairly large problems that cannot be settled without the co-operation of a number of specialists and much actual experimentation.

### Pressure Lubrication

Pressure feed lubrication for the main bearings, crankpin bearings and pistonpin bearings has proved the best system by actual experiment with various systems. Oil is best circulated by a gear-type pump driven from the crankshaft. Such a system enables rapid circulation of the oil and permits ready cooling and the filtering operations that must be provided for the best engines.

Business policies forbid recommending a definite trade marked brand of suitable oils and therefore entail extensive experimenting on the part of the engine builder.

Lubrication of the main, crankpin, and pistonpin bearings of a Diesel engine is not especially difficult once the proper oil has been selected.

The selection of the oil involves, however, such matters as proper viscosity at wide ranges of temperature, since the oil is subject to fairly high heat on account of coming in contact with the piston and cylinder walls and ability to retain its lubricating qualities and not break down when so heated. Emulsification is also a problem.

With all these highly technical problems at hand the engine builder cannot but consult the various refiners, submitting specifications of a general nature as, "the oil should be a medium heavy, straight run, pure mineral oil carefully refined; must have a viscosity of 400 to 500 secs. Saybolt at 100 deg. F. and 60 to 70 at 210 deg. F. if of a paraffine base; if of an asphaltic base the viscosity must be 500 to 700 secs. Saybolt at 100 deg. F. and 60 to 70 at 210 deg. F. Flash point must not be below 350 deg. F."

These specifications enable the oil refiner to make a recommendation based on his knowledge of operating conditions. The final test is necessarily that of an actual period of operation with the oil, which is observed by both refiner and engine builder.

Many different brands of oil are brought in to the manufacturing plant and tested and records kept to make it possible to give the engine owner a suitable recommendation of an oil obtainable in his locality.

One grade of oil will lubricate all bearings and sliding surfaces although a slight difference in the oil for the power cylinder may be advisable. This is also arrived at by experiment starting from the original specifications listed above. A lubricator of the force feed type lubricates power cylinders. Strict attention to the grade of oil used is demanded.

Where the speed of the driven machine will permit it, the direct drive is the most satisfactory. In the case of a generator this is most frequently used, the drive being direct through a rigid coupling or an extension of the crankshaft. Ease of alignment permits such a construction and the alignment once made is easy to maintain, since the generator is a compact machine of few parts.

### Selection of Coupling

When other machinery is to be direct driven at engine speed a flexible coupling is most often employed. The nature of the driven machine's torque affects somewhat the selection of the type of coupling to be used. In driving air compressors the torque of the compressor when partially unloaded is very uneven and pulsates to such an extent that backlash occurs. Any coupling with backlash is unsuitable for this application. The most suitable coupling is a laminated spring-steel ring-type which is capable of compensating for a large amount of misalignment and which allows no backlash. Such couplings have to be larger in proportion to the maximum torque transmitted than those transmitting uniform torque.

Belt drive is gradually losing favor although it is still extensively employed for engine drives. Belt wheels are usually mounted on a shaft extension or stub shaft rigidly bolted to the engine shaft. On account of the starting conditions of Diesel engines a clutch is required either on the driving or the driven pulley, so that turning over of the engine is made easy when starting.

A new type of rope drive has lately been developed which is adaptable to engine drives. This drive employs specially made individual ropes running in vee-shaped grooves. Short pulley centers are used and a compact, relatively efficient drive is afforded.

Any of the heavy duty gear drives are satisfactory though seldom employed. Gears are, as a rule, noisy unless kept in perfect axial and pitch alignment, and where the pinion is mounted on the engine shaft and the gear on a separate machine not an integral part of the engine or its base, alignment is extremely difficult, and operation is far from satisfactory. When, however, the pinion and gear are assembled in one housing permitting the pinion shaft to be coupled to the engine shaft by a flexible coupling, the drive is entirely satisfactory. Many such drives are successfully employed in driving oil pipe line pumps.

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Heat-treating is being used more and more on such materials as cast iron, cast steel, sheet metal stampings, and aluminum-alloy sheets and castings. In some plants, all fragile castings are heat-treated to remove internal strains before being machined. This reduces the percentage of accidental breakage and also prevents much distortion that formerly occurred after the castings were machined.

# Getting Ideas from the Men

"WHAT do you think of suggestion boxes, Mr. Holland?" Holland was lunching with John Baker of the Milburn company, who wanted some new ideas about running his shop.

"I think their usefulness usually depends more on the management than on the men, Mr. Baker. I've known them to prove highly successful, and also to be a dead failure."

"But if it's a good plan why should it ever fail?"

"For the same reason that some men get 100 per cent out of their machinery while others always have trouble. Depends on how it is run, Mr. Baker."

"Some tell me they never get any worthwhile suggestions and that men get peeved when their ideas are not adopted."

"If they don't get any good suggestions they are either mighty near perfect now, or they don't attract the right men, or they are so bull-headed they don't want suggestions from anyone else. We both know that kind, Mr. Baker. But suggestion boxes do work out well in many progressive plants."

"Men always looking for rewards, I suppose?"

"And why not? Aren't we all? And you ought to be mighty glad to pay them for ideas that save you money."

"But don't they get an exaggerated idea of their value and feel they ought to get more money?"

"Probably, at times. We're all apt to feel that way. But it's possible to show them how few dollars are saved in many cases. On the other hand, if a suggestion does save a lot of money, the man who made it deserves a real reward."

"Is there any other way of getting ideas from the men, Mr. Holland?"

"Several. One of my good friends gives a dinner to his foremen once a month. After they've kidded each other a while and had a good meal, each draws an envelope with a few questions in it. The man who draws the questions answers them as best he can. The others discuss his answers if they don't agree.

"It's some job getting up all the questions but it's proved worth while. And he also gives a bonus when the answers save the company money enough to warrant."

"But that plan hits only the foremen, Mr. Holland."

"That's true, Mr. Baker. He also runs a suggestion box in each department. And every question is carefully considered by a committee. Every suggestion is answered, too—with a good reason for not adopting it, if it's turned down."

"Seems like a lot of work, Mr. Holland. Does it really pay?"

"The only answer I can give is that the most progressive concerns I know use it in some form or other."

"Do they give a flat reward—or vary it according to the value of the idea?"

"Some use one method, some another. One of the best firms I know has a minimum reward for any idea accepted. If it proves to be worth more, an additional award is given later. In a few cases a man's rate is increased as a substitute for a fixed reward. No two seem to agree as to the best method."

"I'm still wondering if it's worth while, Mr. Holland."

"Well, continue to wonder for a while, if you're not satisfied it will work. It's much better to do the thinking in advance. I think you will agree with me that there isn't anything worse than trying to get co-operation from the men on something you only half believe in yourself."

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Executives are invited to discuss the problem involved in the foregoing case. Accepted contributions will be paid for.

# EXECUTIVE FORUM

## *Discussion*

### Which Type of Equipment?

Special equipment should only be considered when full control of the resultant product is with the firm that makes the investment in special equipment. Where design control is outside of the organization, there is only one safe basis on which such orders can be booked, and the prospect of future orders is not safety. If the bidder for the contract for the parts will learn from the manufacturers of die-casting products, he will work with safety. This consists of splitting the bid into two items, the special equipment and the parts themselves. In such a case, if the purchaser of parts is sincere, he makes the investment in the special equipment with an assurance of low prices on all quantities of parts. The sooner this business of supplying machine parts is put on a rational basis, with the risk placed where it properly belongs, the better it will be for all concerned.

—Raymond C. Bewley.

### Making Power or Buying It

There can be no question about making power where most of the exhaust steam can be used for heating or process work. In many instances, also, Diesel engines are operating generating sets and producing power at a cost lower than bought current. A check up would most likely show that Diesel-operated generating sets during the summer would be more profitable for places where steam is used for heating in the winter.

A certain power plant some time ago was under the impression that it was purchasing current for 1½ cents per kw.-hr., but a detailed check showed that it was actually costing more than 4 cents. There were three boilers already installed in the plant, but only one in operation, and no additional labor would have been required to operate a generating set. In another case current was being purchased at the low rate of 1.64 cents a kw.-hr. by a large manufacturer whose company was finally convinced that it could make power cheaper. Accordingly it installed a set costing $22,140, and the savings amounted to $16,171 a year even in comparison with the former low rate.

It is oftentimes possible to improve the existing layout either by installing a modern engine or by checking closely on the plant operation. I know of one plant where about 1,000 tons of fuel a month was saved with very little effort; and prior to that it was making current cheaper than it could be purchased. The fuel consumption was about 125 tons a day. There are many such instances that could be given. For a small shop using not over 50 hp., it would usually be cheaper to buy the current, although many small shops are being operated economically with oil engines. Beyond 50 hp. each problem should be analyzed carefully by one capable of passing judgment. Usually advice from those selling current is prejudiced. A plant is usually no better than its chief engineer.

—P. W. Lamson.

### About Wage Incentives

The foundation of any wage incentive plan is the job specification and inspection. Tools, machines, material, power and other conditions need not be ideal in order to begin with an incentive plan and derive benefit from it. In fact, there is some advantage to setting incentive standards with conditions only reasonably sound, because after a careful time study and an inauguration of the system to a particular operation or job, the operator's and supervisor's ingenuity to improve conditions is directly utilized to the benefit of the firm. This is done by writing specifications of the conditions of doing the work, such as speeds, feeds, tools, material handling and other factors, and strict enforcement of these specifications.

When any of the specifications are violated the contract is void until, by a new time study under the improved conditions, a new standard is set. Since there is a constant improvement of conditions, specifications are continually changed. This prevents an unreasonably high wage and, its corollary, rate cutting. Rate cutting must never be done. Instead, if a rate is unreasonably high, conditions should be changed by improving the method and setting a new rate from the new specification.

—Rudolf Bearer.

### Discouraging Cancellations

Cancellations are undoubtedly one of the worst forms of abuse in any industry. In the case of fluctuating markets, where only price is the consideration, the honest man stands to lose on both ends without much recourse beyond the other fellow's honesty. In the instance cited, Mr. Holland's suggestion is undoubtedly the most logical move that could have been made—after the incident has happened.

There is, however, a decided tendency to avoid such predicaments where dies, patterns, etc., are involved, by quoting these as separate items when setting a price on parts so produced. While this may have a tendency to imply ownership of the dies as being vested in the purchase, this, after all, is not a serious handicap.

—Edward J. Ferguson.

# *Equipment Makes Possible The Ford Model A*

## Operations on the Transmission Case, the Gears and the Gear Shifter Housing

By Fay Leone Faurote, M.E.

THE transmission of the new Model A Ford is of the selective sliding gear type. It has three speeds forward and one reverse, with a standard shift. The case and the gears are designed with a view to compactness and high mechanical efficiency. All the gears are made of heat-treated chrome-alloy steel, laid out and manufactured in the most careful manner.

The main shaft runs on ball bearings, the countershaft on roller bearings, and the reverse idler on a bronze bearing.

The clutch is of the well-known multiple dry-disk type and has four driving disks and five driven disks.

Within the limited space of these articles it will not be possible to describe in detail the exact method of manufacture of all the transmission parts, so attention will be confined to some of the main or larger units, such as the transmission case, the gear shift housing, the transmission main shaft, the high and intermediate sliding gear, the countershaft gear, the reverse idler gear, the clutch, the clutch housing, the clutch disk drum, the flywheel, and flywheel housing, and will close with an outline of the method of general assembly.

The machine operations on the transmission case begin on a four-spindle Ingersoll drum-type milling machine which it is estimated will mill the top faces of about 189 transmission cases per hour. A 21-in. Cincinnati six-spindle multi-head drill then sinks six $\frac{5}{16}$-in. tap holes at the rate of 125 parts an hour. The third and fourth operations rough bore and face, finish bore, face and ream front and rear ends. The operations are performed on an 8-in. six-spindle Bullard Mult-Au-Matic, single index, at the rate of 50 an hour. The fifth and sixth operations are the rough drilling of a $\frac{3}{4}$-in. and a $1\frac{3}{8}$-in. hole on a 21-in. two-spindle Cincinnati drill, and the line reaming of the same on a 21-in. single-spindle Cincinnati, followed by the line reaming of two other holes, one 0.750/0.751 in. and the other 0.749/0.650 in. The eighth operation takes care of one $\frac{3}{8}$-counterbore on the boss inside and is performed on a 21-in. Cincinnati drill. The ninth operation, which is performed on a spe-

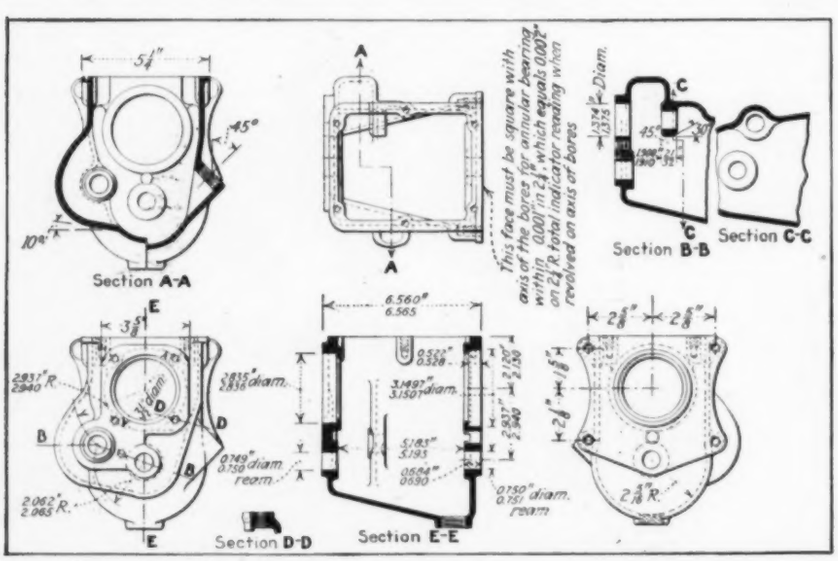

Section A-A
Section B-B
Section C-C
Section D-D
Section E-E
This face must be square with axis of the bores for annular bearing within .0001 in 2½ which equals .0002" on 2½ R. total indicator reading when revolved on axis of bores

*Fig. 1—The transmission case. The iron from which the case is cast is of a special grade, indicated in the Ford plant by the letter B. The maximum hardness of the casting must not exceed 228 on the Brinell scale*

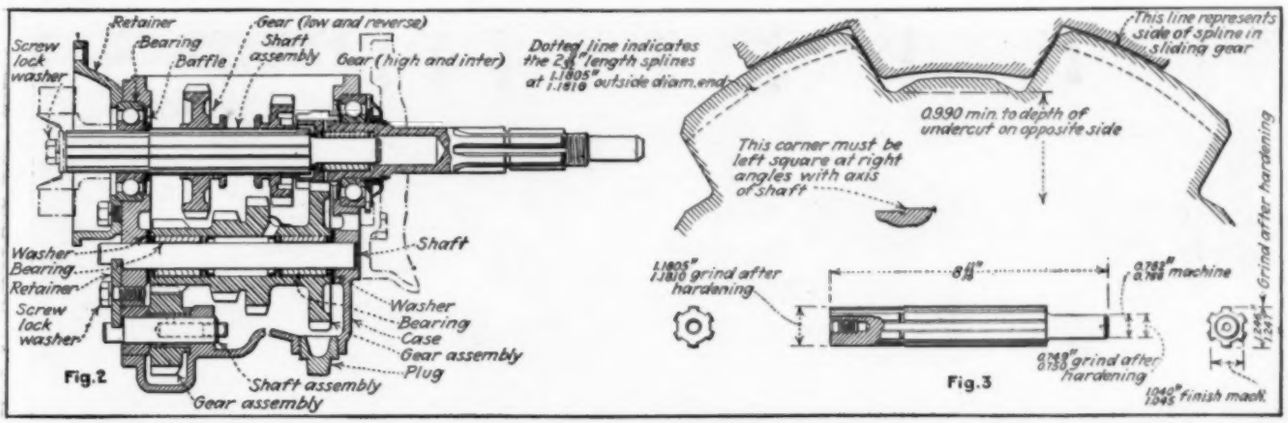



*Fig. 2—Transmission assembly. Fig. 3—Transmission main shaft. This shaft is annealed at 1,500 deg. F., cooled in the furnace to 1,150 deg. F., and allowed to cool in the air to produce a hardness of from 187 to 217 Brinell. It is again heated to 1,500 deg. F. in cyanide and then quenched in oil. It is drawn in oil at 400 deg. F. The hardness is from 477 to 532 Brinell. The shaft is mounted in ball bearings of ample size*

cial Natco three-way drill of the cam-feed type, drills one ¼-in. tap hole, one $\frac{7}{16}$-in.-14 tap hole, one ½-in. hole, four $\frac{7}{16}$-in.-20 tap holes, one ⅜-in.-16 tap hole. The tenth, eleventh, twelfth and thirteenth operations are all performed on 21-in. Cincinnati drills, the first two being ¼-in. pipe-tap holes on side and in bottom, the third and fourth, four $\frac{7}{16}$-in. and one ⅜-in. tap holes and four $\frac{7}{16}$-in. holes and one ½-in. hole, respectively. These latter operations are performed on drills with five-spindle heads.

A special Ford four-way, sixteen-spindle horizontal and vertical machine performs the fifteenth operation, which consists of tapping simultaneously six $\frac{5}{16}$-in.-18 holes, four $\frac{7}{16}$-in.-14 holes, four $\frac{7}{16}$-in.-20 holes, one ⅜-in.-16 hole and a ¼-pipe-tap hole on the bottom. This operation is followed by five other tapping operations as follows:

| | | | |
|---|---|---|---|
| 16 | Tap six $\frac{5}{16}$-in. - 18 holes | 21-in. Cincinnati drill, with reversing switch, single spindle | 150 |
| 17 | Tap four $\frac{7}{16}$-in. - 14 holes | 21-in. Cincinnati drill, 4-spindle multi-head, reversing switch | 150 |
| 18 | Tap four $\frac{7}{16}$-in. - 20 and (1) ⅜-in. - 16 holes | 21-in. Cincinnati drill, 5-spindle multi-head, and reversing switch | 150 |
| 19 | Tap ¼-in. pipe hole on bottom | 21-in. Cincinnati drill. single spindle | 175 |
| 20 | Tap ¼-in. pipe hole on side | 21-in. Cincinnati drill, single spindle, with tapping attachment | 175 |

The operation sheets for the gear shift housing, the transmission main shaft and the various gears follow:

## Gear Shift Housing Operation Sheet

| No. | Operation | Machine | No. per Hr. |
|---|---|---|---|
| 1 | Mill bottom | 1—No. 1 Davis & Thomson 4-spindle drum type milling machine | 100 |
| 2 | Mill end | 1—No. 1 Davis & Thomson 4-spindle drum type milling machine | 300 |
| 3 | Drill six $\frac{13}{32}$-in. bolt holes | 2—21-in. Cincinnati drill with 6-spindle multi-head power feed | 150 |
| 4 | Drill two shifter shaft holes for 0.561/0.563-in., ream | 4—21-in. Cincinnati drill with 2-spindle multi-head | 60 |
| 5 | Line ream 0.561/0.563 in. shifter shaft, two holes | 1—21-in. Cincinnati drill with 2-spindle multi-head | 180 |
| 6 | Drill ¼-in. hole and spot face 20 deg., $1\frac{13}{16}$-in. diameter inside of neck | 1—21-in. Cincinnati drill hand feed | 100 |
| 7 | Drill $\frac{5}{16}$-in. hole in rear side of housing | 2—20-in. Cincinnati drill, hand feed, single spindle | 200 |
| 8 | Drill hole for 0.436/0.438-in. ream for gear shifter plunger | 2—21-in. Cincinnati single spindle drill, hand feed | 80 |
| 9 | Ream 0.436-in./0.438-in. hole for gear shifter plungers | 1—21-in. Cincinnati drill, hand feed, single spindle | 150 |
| 10 | Rough turn spherical radius on end of neck | 1—20-in. Cincinnati Ford type drill with vertical motor, single spindle, hand feed | 70 |
| 11 | Finish turn spherical radius on end of neck | 1—21-in. Cincinnati drill hand feed, single-spindle | 80 |
| 12 | Spot face six bolt holes | 1—21-in. Cincinnati drill 6-spindle multi-head, hand feed | 175 |
| 13 | Mill 0.254/0.258-in. slot | 2—No. 2 Pratt & Whitney hand mill | 65 |
| 14 | Tap ½-in.- 20 hole | 1—21-in. Cincinnati single-spindle drill with reversing motor switch, hand feed | 200 |

## Transmission Main Shaft Operation Sheet

| No. | Operation | Machine | No. per Hr. |
|---|---|---|---|
| 1 | Cut to length | 1—No. 55 Acme auto screw machine, 4 spindles | 150 |
| 2 | Normalize 1,500 to 1,650 deg. | 1—Ford design oil and gas furnace | 240 |
| 3 | Center both ends | 1—18z-447 Ford double end centering machine | 150 |
| 4 | Rough turn diameter of long and short spline bearing | 6—O X 5 Reed-Prentice lathe, power feed tailstock—taper in headstock | 45 |
| 5 | Turn short spline bearing to length and recess | 2—O X 5 Reed-Prentice<br>2—O X 5 Reed-Prentice lathe, power feed—taper in headstock and tailstock | 180<br>180 |

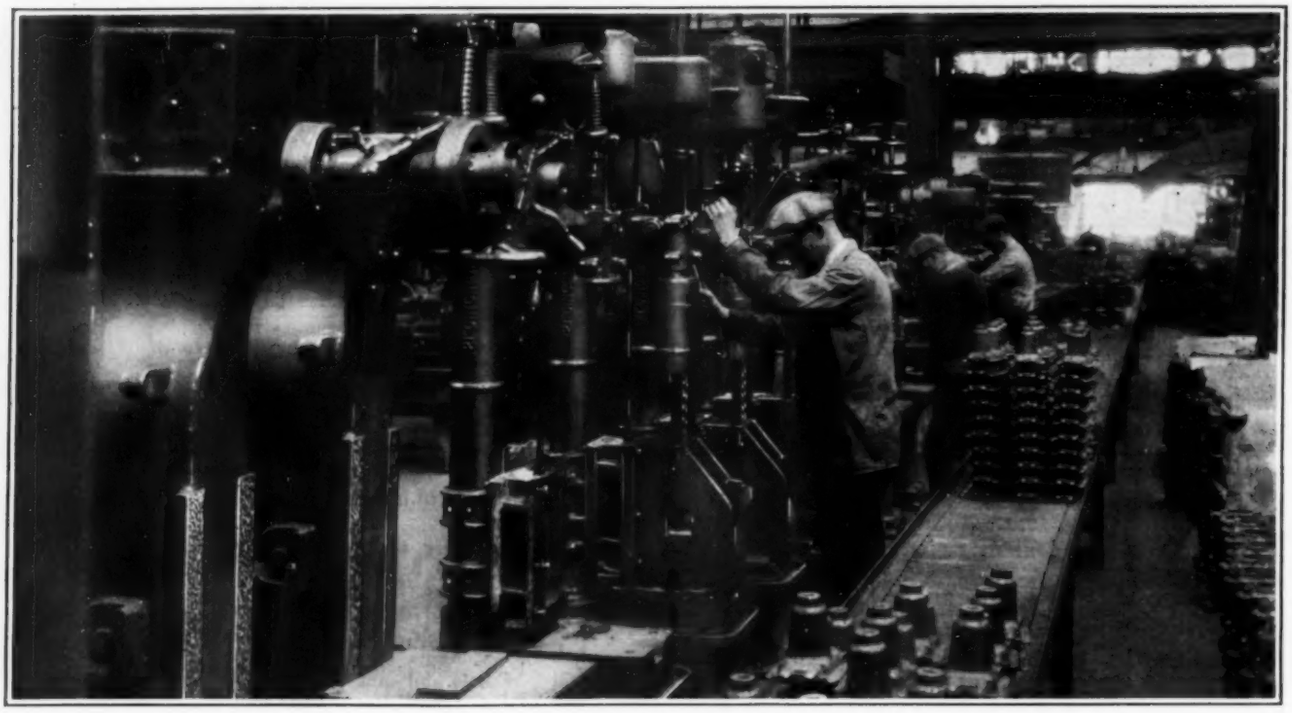


*Fig. 4—The gear shifter department*

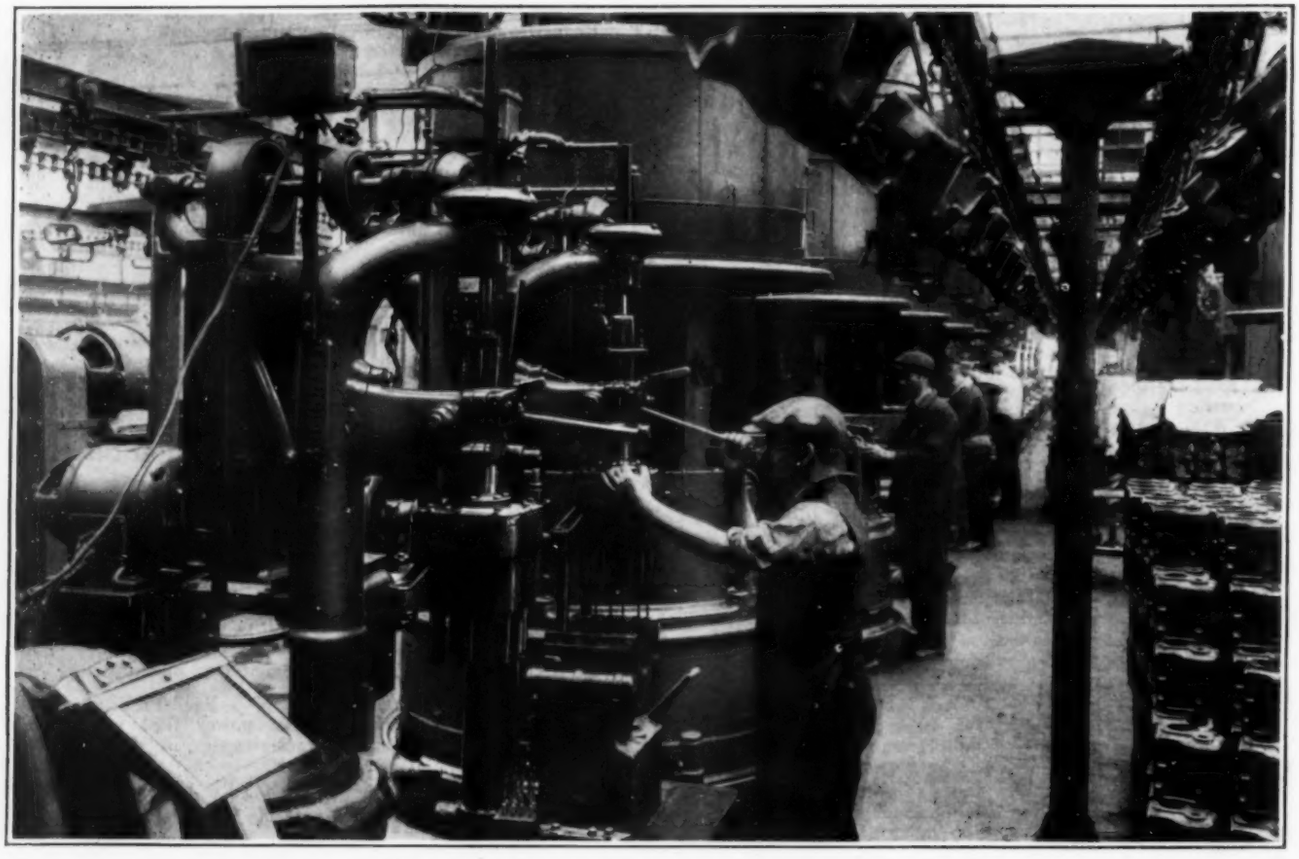


*Fig. 5—Where the transmission cases are machined*

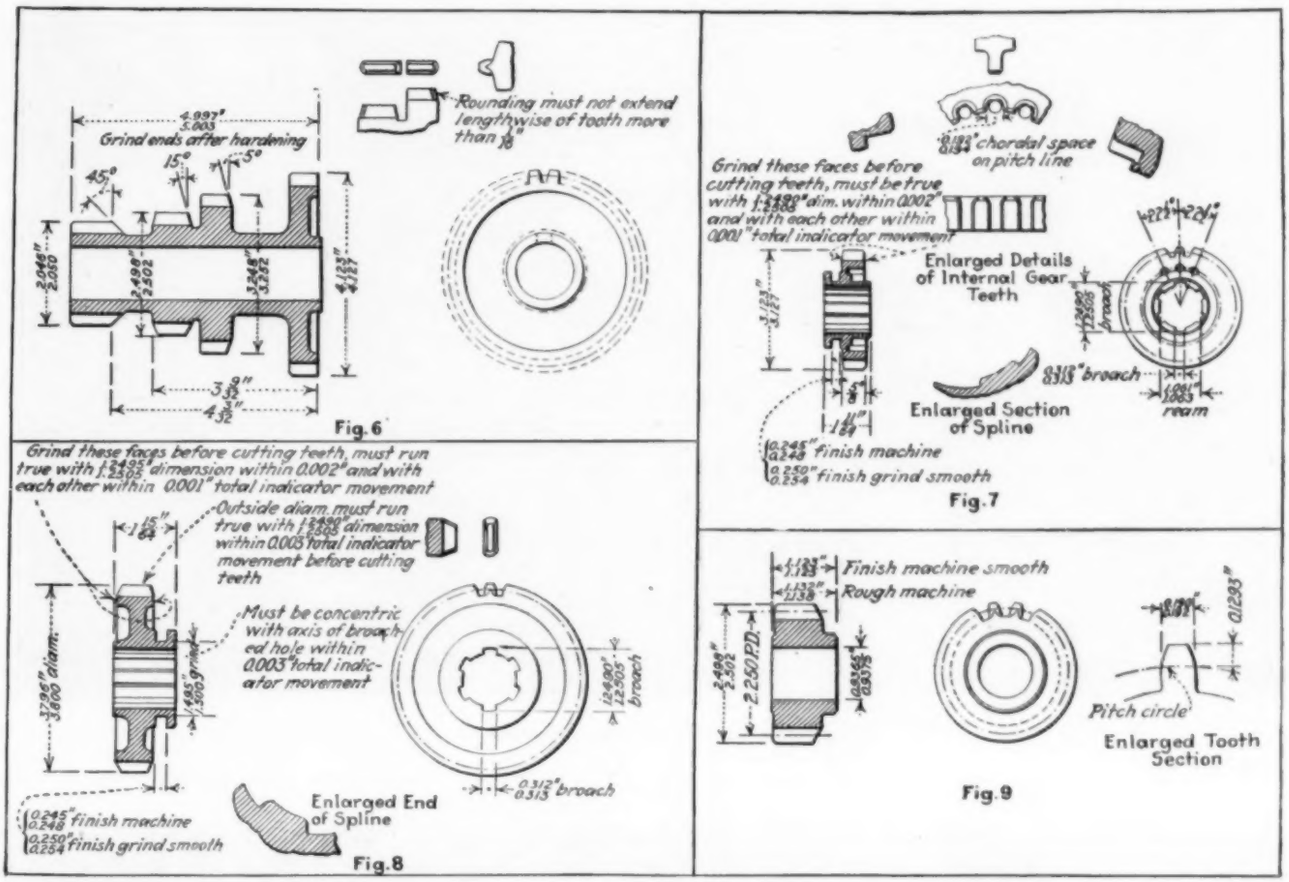

Rounding must not extend lengthwise of tooth more than 1/16"
Grind ends after hardening
Fig. 6
Grind these faces before cutting teeth, must be true with 1.2480" dim. within 0.002" and with each other within 0.001" total indicator movement
0.183" chordal space on pitch line
Enlarged Details of Internal Gear Teeth
Enlarged Section of Spline
0.312" broach
0.313
ream
0.245" finish machine
0.248
0.250" finish grind smooth
0.254
Fig. 7
Grind these faces before cutting teeth, must run true with 1.2495" dimension within 0.002" and with each other within 0.001" total indicator movement
Outside diam. must run true with 1.2490" dimension within 0.003 total indicator movement before cutting teeth
Must be concentric with axis of broached hole within 0.003 total indicator movement
broach
Enlarged End of Spline
0.245" finish machine
0.248
0.250" finish grind smooth
0.254
Fig. 8
Finish machine smooth
Rough machine
2.250 P.D.
Pitch circle
Enlarged Tooth Section
Fig. 9

*Fig. 6—The cluster gear. Fig. 7—The high and intermediate sliding gear. Fig. 8—The low and reverse sliding gear. Fig. 9—The reverse idler gear. All of these gears are made from annealed forgings and are heated to 1,500 deg. F. in cyanide and quenched in oil. They are then drawn in oil at 400 deg. F. for one hour*

| | | | |
|---|---|---|---|
| 6 | Rough turn pilot bearing | 3—O X 5 Reed-Prentice cam lever tailstock, power feed lathe | 45 |
| 7 | Rough grind pilot bearing | 2—10x24-in. Landis grinder | 50 |
| 8 | Rough grind short spline bearing | 2—10x24-in. Norton grinder | 90 |
| 9 | Rough grind long spline bearing | 2—10x24-in. Norton grinder | 50 |
| 10 | Stamp "Ford" | Hand operation | ... |
| 11 | Hob splines | 7—No. 12 Barber-Colman gear hobber | 10 |
| 12 | Mill 45 deg. on ends of splines | 1—No. 1 Toledo hand mill | 100 |
| 13 | Drill letter Q- and 23/64-in. holes in end of shaft | 1—No. 1 Foote-Burt 4-spindle drill, power feed | 67 (per spindle) |
| 14 | Tap 3/8-in.-24 thread | 2—No. 2 Garvin tapper | 100 |
| 15 | Heat in cyanide and quench in oil | 1—Ford cyanide pot | 160 |
| 16 | Draw in oil | 1—Holcroft electric furnace | 720 |
| 17 | Remove bolt out of tapped hole | 18z-709 nut spinner. Also used to insert bolt, operation No. 15-A | ... |
| 18 | Inspect hole and thread | Hand operation | ... |
| 19 | Retap 3/8-in.-24 thread to remove clay | 1No. 2 Garvin tapper | 100 |
| 20 | Grind 15-deg. angle on pilot bearing by locating off of long spline. | 2—6x18-in. Landis grinder | 85 |
| 21 | Grind 45-deg. chamfer on both ends of splines | 2—6x18-in. Landis grinder | 50 |
| 22 | Grind pilot bearing, finish | 2—10x18-in. Norton grinder | 45 |
| 23 | Grind long spline bearing | 2—10x18-in. Norton grinder | 35 |
| 24 | Grind short spline bearing | 2—10x18-in. Norton grinder | 45 |
| 25 | Grind 45 deg. on top edges of spline | 1—No. 4 LeBlond universal grinder | 90 |
| 26 | Polish scale off of root diameter of splines | 1—1½-in. Cincinnati grinder, universal | 100 |
| 27 | Final inspection | Hand operation | ... |

## Transmission High and Intermediate Sliding Gear Operation Sheet

| No. | Operation | Machine | No. per Hr. |
|---|---|---|---|
| 1-F | Heat and forge | 1—Electric furnace | 125 |
| 2-F | Heat-treat | 1—Holcroft electric furnace | 720 |
| 3-F | Tumble | 1—28 in. x 19 ft. Sly sprue mill | 1,200 |
| 1 | Chuck large hub, end up, drill and ream 1.061/1.063-in. hole, face end of hub and cut recess | 2—8-in. 6-spindle Bullard, single index | 39 |

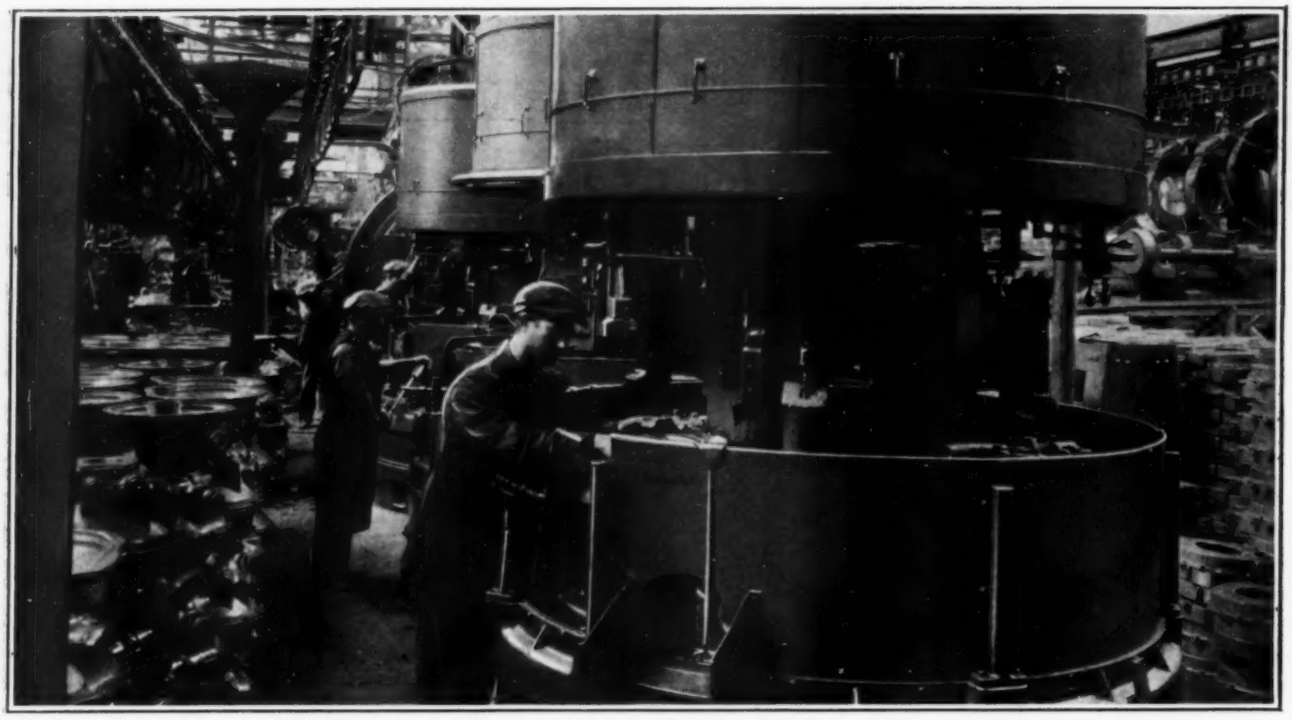


*Fig. 10—Machining clutch housings*

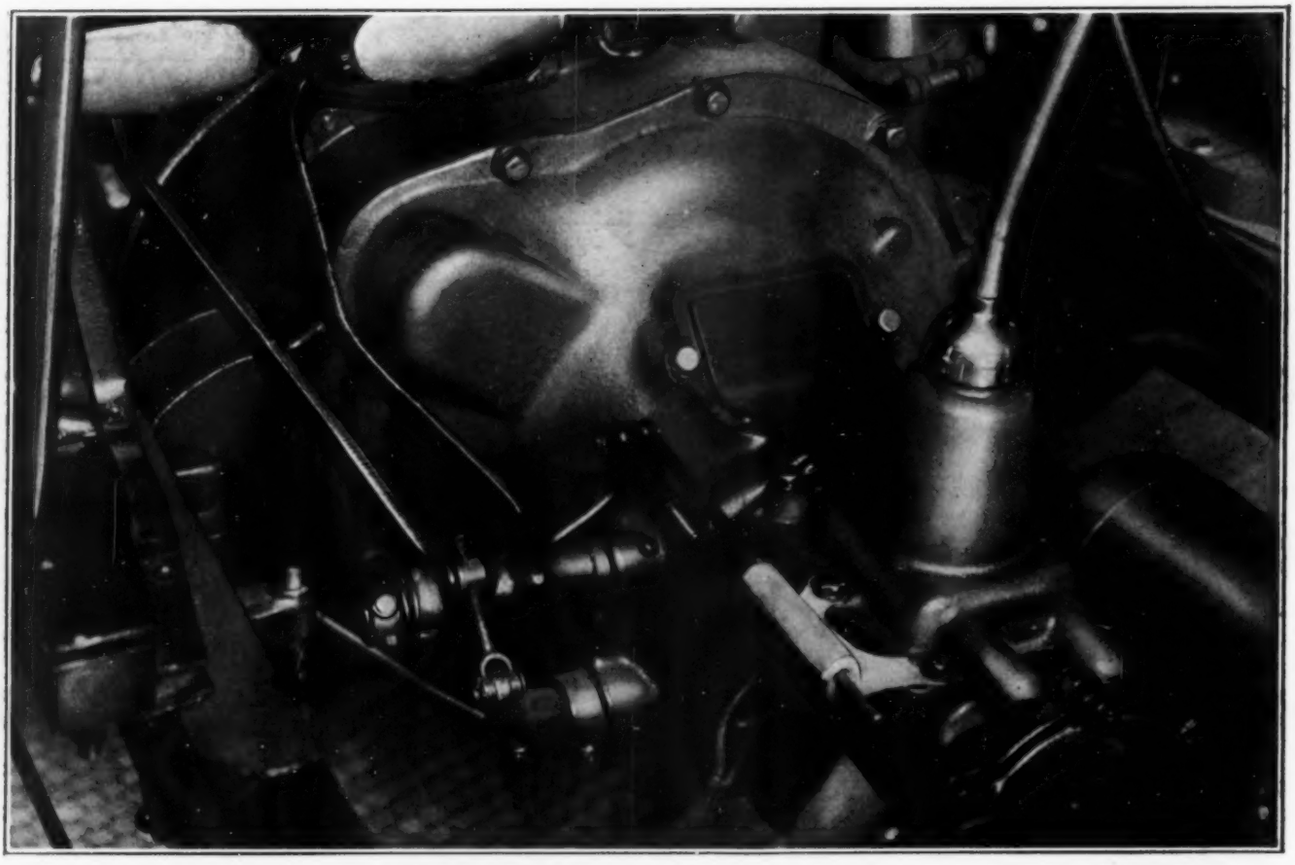


*Fig. 11—Transmission in place in the chassis*

| | | | |
|---|---|---|---|
| 2 | Spline broach hole (three passes) | 2—No. 1 Knowles keyseater | 40 |
| 3 | Mount on splined arbor, turn O.D., straddle face, cut angle | 2—8-in. 6-spindle Bullard single index | 54 |
| 4 | Drill (16) $\frac{11}{64}$-in. holes for internal teeth | 1—20-in. Cincinnati drill heavy duty Ford type with 16-spindle multihead and vertical motor, power feed and index fixture | 185 |
| 5 | Countersink sixteen $\frac{11}{64}$-in. holes for chamfer of internal teeth | 1—21-in. Snyder drill, single spindle | 250 |
| 6 | Recess for internal teeth | 2—20-in. Cincinnati drill heavy duty Ford type with vertical motor, power feed | 50 |
| 7 | Chamfer edge of recess | 1—No. 3 Potter & Johnston screw shaver | 310 |
| 8 | Inspect blanks | Hand operation | ... |
| 9 | Rough cut external gear teeth | 4—No. 12 Barber-Colman gear hobber | 31 |
| 10 | Strain (draw) | 1—Electric furnace | 3,640 |
| 11 | Rough punch internal teeth | 1—P-s Ferracute press | 275 |
| 12 | Redrill to remove burr of internal teeth | 1—16-in. Reed-Prentice drill with 4-spindle multihead, hand feed | 300 |
| 13 | Remove burr in recess of internal teeth | 1—20-in. Cincinnati heavy duty Ford type drill with vertical motor, power feed | 250 |
| 14 | Finish internal teeth with formed punch | 1—P-3 Ferracute press | 270 |
| 15 | Redrill second time to remove surplus stock of internal teeth | 1—16-in. Reed - Prentice drill with 4-spindle multihead, hand feed | 300 |
| 16 | Finish broach with spline broach | 1—No. 1 Knowles keyseater | 145 |
| 17 | Grind sides of gear blank | 1—10x24-in. Norton grinder | 65 |
| 18 | Finish cut external teeth and inspect | 18—Special Fellows gear shaper | 19 |
| 19 | Chamfer teeth | 1—PA-2 Ferracute press | 120 |
| 20 | Burr all edges | Hand operation | ... |
| 21 | Cyanide and quench in oil | 1—Ford design cyanide furnace | 360 |
| 22 | Wash | Ford washer,overhead conveyor through washer | 2,000 |
| 23 | Draw in elect. furnace | 1—Electric furnace | 2,400 |
| 24 | Test | 3—No. 3-F Rockwell tester | 600 |
| 25 | Grind shifter groove | 1—Landis grinder | 35 |
| 26 | Inspect | Hand operation | ... |

## Transmission Countershaft Gear Operation Sheet

| No. | Operation | Machine | No. per Hr. |
|---|---|---|---|
| 1-F | Cut $1\frac{1}{4}$-in. bar stock to 12 in. long | 1—No. 4 Hilles & Jones shear | 250 |
| 1 | Heat and forge | Holcroft - Globar electric furnace | ... |
| 2-F | Heat and forge small end, that is 15th and 18th and 24th tooth end | 1—4-in Ajax forging machine<br>1—Holcroft electric furnace | 100 |
| 3-F | Forge large end 31 teeth | 1—Ajax forging machine | 100 |
| 4-F | Heat-treat | 1—Holcroft electric furnace | 300 |
| 5-F | Tumble | 1—8 in. x 19 ft. Sly sprue mill | 350 |
| 1 | Chuck in Bullard, large end up drill and ream 1.080/1.082-in. hole, recess, turn gear, rough face gear | 7—8-in. 6-spindle Bullard, single index | 24 |
| 2 | Spot face small end | 1—20-in. Cincinnati heavy duty drill Ford type with vertical motor, hand feed | 150 |
| 3 | Drill $\frac{5}{16}$-in. hole between 21-tooth and 24-tooth gear | 1—21-in. Cincinnati single spindle drill, power feed | 200 |
| 4 | Broach 1.111/1.112-in. hole | 1—No. 1 Knowles keyseater | 125 |
| 5 | Face large end and finish turn O.D. and chamfer 45 deg. x $\frac{1}{32}$-in. x $\frac{1}{16}$-in. on flat | 1—No. 0x5 Reed-Prentice lathe, taper in headstock and tailstock | 25 |
| 6 | Rough 31 teeth | 6—No. 12 Barber-Colman gear hobber | 22 |
| 7 | Mount on arbor in Bullard and drive from teeth, turn and chamfer all diameters | 3—8-in. 6-spindle Bullard Multi-Au-Matic, single index | 31 |
| 8 | Inspect blanks | Hand operation | ... |
| 9 | Rough cut gears 24 teeth | 4—No. 12 Barber-Colman gear hobber | 23 |
| 10 | Rough teeth 15-T gear | 4—No. 12 Barber-Colman hobber | 30 |
| 11 | Rough teeth 18-T gear | 12—No. 7 Fellows gear shaper | 27 |
| 12 | Strain (draw) | 1—Electric furnace | 728 |
| 13 | Broach 1.118-in. hole | 1—No. 1 Knowles keyseater | 125 |
| 14 | Grind face of large gear true with hole | 1—12x32-in. Landis grinder | 75 |
| 15 | Finish cut 15 teeth | 12—No. 7 Fellows gear shaper | 12 |
| 16 | Finish cut 18 teeth | 14—No. 7 Fellows gear shaper | 13 |
| 17 | Finish cut gear 24 teeth | 17—No. 7 Fellows gear shaper | 11 |
| 18 | Finish cut gear 31 teeth | 17—No. 7 Fellows shaper | 9 |
| 19 | Chamfer teeth 18-T gear | 1—PA.-2 Ferracute press | 180 |
| 20 | Chamfer teeth 24-T gear | 1—PA.-2 Ferracute press | 120 |
| 21 | Cyanide and quench in oil | 2—Fixture | 48 |
| 22 | Wash | 1—Ford washer with overhead conveyor through washer | 1,500 |
| 23 | Draw, electric, 400 deg.F. | 1—Ford electric furnace | 480 |
| 24 | Draw small end (15) teeth in nitrate | 1—Nitrate tank | 160 |
| 25 | Test | 1—No. 3-F Rockwell tester | 400 |
| 26 | Grind hole | 3—No.15 Giddings & Lewis Teromatic grinder<br>1—No. 72-A-3 Heald grinder, single end<br>1—No. 72 Heald grinder, double end | 22<br>15<br>45 |
| 27 | Grind both ends to length | 2—10x24-in. Norton grinder | 28 |
| 28 | Inspect | Hand operation | .. |

***The next Ford article will tell about the Flywheel and Clutch Housings***

## · THE · FOREMAN'S · ROUND · TABLE ·

*The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared*

# *Making the New Planers Pay*

"SOME of the boys read Williams' 'Shop News' anyhow, Ed," said Al after the third issue had been out a few days. "I overheard two of them discussing the cost of those new planers the company ordered."

"Can't see why they should worry about the cost—all they have to do is to run them."

"Still trying to be hard-boiled, eh? Nobody wants them to 'worry' about the planers. That's the management's job. All Williams wants is for the men to get interested in the shop, in the work, and in the machines."

"What did they say about the planers, Al?"

"They were surprised at the cost, for one thing. 'Didn't know they cost so much more than they used to,' said one. 'Of course they do, Bill,' said the other, 'see how they've been changed and improved. Long beds so there's no overhang of the table, power movement on all heads. They're certainly much better machines to run than they used to be.' Said a lot more, too, Ed."

"Suppose they wanted different paint or something."

"You'll be surprised at what they discussed most, Ed. It was about the cost and how it could pay to spend so much money for new planers. One of them even went so far as to figure up the interest on the investment. And you can't tell me that he won't be more careful of that planer and try to get more work out of it so as to help make it pay for itself as soon as possible."

"You're an optimist, Al. Sounds like idle curiosity to me. Bill always was a nut on figures."

"Well, he's figured a way to buy a nice little home anyhow, Ed. Guess that's why he thought about interest on the planer."

"What did the other chap say about it? Bet he didn't do any figuring."

"You're right, Ed. But he had a slant that had its good points, too. He said, 'Bill, if the old man is willing to gamble over twenty-five thousand dollars on those new planers, especially when we aren't any too busy in the shop, he's a dead game sport and a good man to tie to. He isn't afraid business is going to pot and it's up to us to help him make good with his new machines.'"

"Sounds like you made it up, Al. Or else you've been reading some sort of Pollyanna stuff that's turned your head."

"Wrong again, Ed. That's exactly what I heard them say. You're making a mistake if you think all the real interest and brains start with the foreman."

*Is Al over-optimistic as to the interest men will show about the machines? Or does Ed size them up more as they really are? Is it a good plan to tell what new machines cost?*

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

# *Discussion of Earlier Topics*

### How Much to Spend for Repairs?

WHEN the question arises of whether or not excessive repairs have been made to a machine, it indicates that a definite policy concerning such expenditures is lacking. I suggest that a chart be maintained which shows the actual value at any given time, and not the depreciated value, since the greatest real depreciation as far as value is concerned occurs in the first few years of its life. When a repair job is contemplated, it should be estimated in advance, and if this cost exceeds or equals a certain percentage of the value shown by the chart, a new machine should be authorized.

—S. T. GUSTOF.

A MACHINE does not pay dividends to a concern when it needs continual repair. It also produces inferior work, lowers production, gets out of order more easily and causes dissatisfaction. Therefore, I would suggest that not more than 30 per cent of the initial cost be spent upon repairs, during the life of the machine. If with this amount spent upon it, the machine has not earned a good profit, its purchase was not justified.

—W. H. HOAGLAND.

### Putting Color on the Machinery

EXPERIMENTS, which I conducted five years ago, showed conclusively that light colors are best for machinery because they induced more frequent cleaning, and did not absorb much light. Battleship gray was the final choice from among dark blue, light blue, and other colors, because, although it prominently displayed dirt, it was more restful to the eyes of the workmen than other common shades. I am not in favor of using more than one color on machinery because of the expense of painting in the shop, and the greater ease of obtaining the color named on new machines. —R. MAWSON.

### Getting the Wear Out of Machines

SELDOM is a machine run at anywhere near its capacity. The thing to do is to find out what the machine is capable of doing and then see that it is kept going at this rate. However, a machine worked at or near capacity must have the best of care to keep it functioning economically during its productive life.

It is common knowledge that, all other things being equal, an organization with up-to-date equipment is in a better position to produce at lower cost than the firm whose equipment is obsolete and inefficient. In view of this fact it is good business to get out of a machine all that it is capable of producing, in the shortest possible time. —C. H. LATTNER.

## THE · NEXT · TOPIC

**Helping the Firm Make Sales**

ADVANCE QUESTION

*One of Ed's friends makes a sale while out on an erecting job. Ed thinks he should get a commission, but Al disagrees. What do you think?*

### Something Besides the Pay Envelope

THERE is a limit to which wage rates may be raised to stimulate interest, but there are many other ways of obtaining the desired results. One great source of satisfaction to workmen is a knowledge of the operating characteristics of machines which they have built. They are also much interested in a comparison of these machines with competitive products. Brief reports of tests are especially appreciated. It should not be forgotten that men respond to kind words of appreciation. On occasions where extra effort has been shown, an acknowledgment from the general foreman or the superintendent will be of great value. —F. E. CLARKE.

### Extra Pay for Extra Effort

TO CUT the rate immediately for a piece-work job, when a short cut has been discovered, would produce a discouraging effect upon the operator, and would make him think twice before devising further short cuts. A definite policy which should work out favorably, and which would encourage the development of improvements, would be to permit the operator to work and earn as much as possible at the old rate for a certain period, such as thirty days. At the end of that time, the price would then be reduced and the operator could make as much at the new rate as he did before the short cut was discovered. This extra pay would constitute a bonus for the man's interest. —A. S. KOPF.

THE fairest way to handle a new method of production would be to give the operator a bonus for his ingenuity and establish a new piece rate. In this country piece rates can not be changed until the conditions surrounding the operation have been changed, according to trade-union agreements. Under this system a man is permitted to make all that he is able to without fear of an unfair cut. —T. WELSH, *England.*

# The Form Grinding of Circular Form-Tools

By Ellsworth Sheldon
*New England Editor, American Machinist*

GIVEN the drawing of its contour and a piece of steel from which to make a circular form-tool, the method of procedure is at first very much the same as before contour grinding became practicable. The disk of steel is chucked, bored, threaded and faced. It is then screwed on a threaded mandrel, placed between centers in a lathe and the contour turned with steel tools.

When the contour of a circular form-tool has been completed in a lathe, about one-quarter of the toolmaker's time has been expended in making the tool, and the other three-quarters in making it *right*. Since the fine work of finishing has been taken over by the grinding machine the lathe work of making even the most accurate tool is a comparatively rough job, requiring only the first quarter of the time above mentioned. If sizes are within two or three thousandths and the angles are correct within a degree or so, the job is "good enough."

By grinding the contours, advantage is gained in several ways. Few, if any, elaborate lathe tools need be made, as the special shapes necessary can be formed on grinding wheels in a fraction of the time required to lay out, file to line, and temper steel tools. The tool is hardened before the contour is completed by grinding and there is no possibility of a change in shape because of burning or warping. If a tool cracks in the hardening operation, a minimum of labor is lost when it is thrown in the scrap. The greatest advantage of all is that the scale resulting from the hardening process is entirely ground away and the cutting edge presents clean, homogeneous metal, with no tendency to chip or flake.

Then, too, if the drawing specifies somewhere in the contour a channel 0.015 in. or less in width, the chances are that the lathe man would have to make two or three very narrow channeling, or parting, tools before he would be able to finish the groove in the tough steel. Now, such a specification may be ignored entirely, as the channel can be sunk in the solid, hardened body of the tool by a grinding wheel —not without difficulty, to be sure, but with far less trouble than would be encountered in trying to do it with such a thin parting tool.

After the form tools have been hardened and tempered and the sand-blast has removed the scale formed upon them during the process, they are returned to the department wherein they originated, to be finished on the grinding machine. The first job is to mount each tool upon a special floating mandrel and adjust it to run true thereon.

For this work the equipment comprises a pair of bench centers, a soft-metal hammer, a dial indicator mounted upon a standard, and a sufficient number of special mandrels to mount all of the tools that are likely to be undergoing the operation of contour grinding at any one time. When a tool has once been trued up on its mandrel it is advisable not to disturb it until all of the work upon it has been completed. This is not absolutely essential, as a tool can be returned to the mandrel as often as desired, but it is a much more difficult job to set a tool to run perfectly true than to set it within a thousandth or so. The term "floating," as applied to the special mandrels upon which the tools are mounted, is somewhat misleading. As may be seen in Fig. 7, the mandrel is a rigid, one-piece tool having centers in both ends. The projecting end upon which the work is mounted is enough

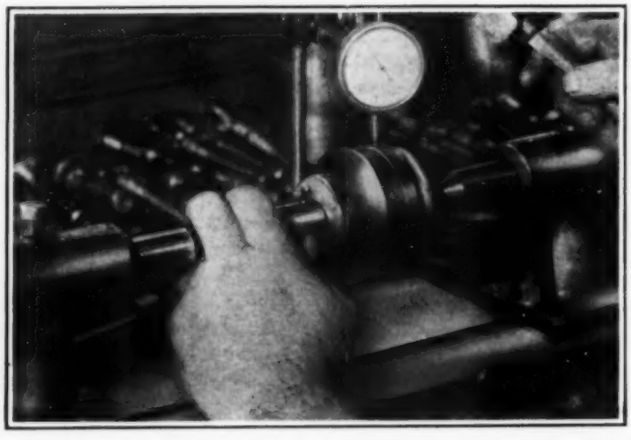


*Fig. 7 — The hardened tools are mounted upon special mandrels that permit them to be trued radially and axially by the aid of a sensitive dial indicator. When so mounted they are ready for the grinding operation upon the contour*

The second of six articles. The third will appear in an early issue.

smaller in diameter than the threaded center-hole of the tool to pass through without touching it, and is itself threaded upon the end for a nut.

In a flange about midway of the length of the mandrel, four small setscrews are put in, parallel to and equidistant from the axis, and it is against the heads of these setscrews that the work is held by the nut, leaving it free to be moved radially. A compensating washer between the nut and the work allows the work to be tilted axially by adjusting the setscrews.

Placing a tool on the mandrel and the mandrel between the bench centers, the operator tightens the nut to hold the work against the setscrews with sufficient pressure to keep it from slipping, yet loose enough to allow it to be moved radially by tapping it with a soft hammer. Applying the dial indicator, the tool is trued radially by tapping it while revolving the mandrel upon the centers, and, changing the indicator to bear upon the side of the tool, it is trued axially by adjusting the setscrews. When true within 0.001 in. radially and 0.0015 in. axially, the nut is finally tightened.

The indicator is so mounted that it can be changed from radial to axial presentation and vice versa with a minimum of effort and time, as it may have to be shifted back and forth several times before the operator is satisfied with the accuracy of the mounting. A degree of skill acquired by long practice, however, enables him to do the work in little more time than is required to describe the operation.

On the grinding machine, the mounted tool is placed between centers as in Fig. 8 and is rotated before the

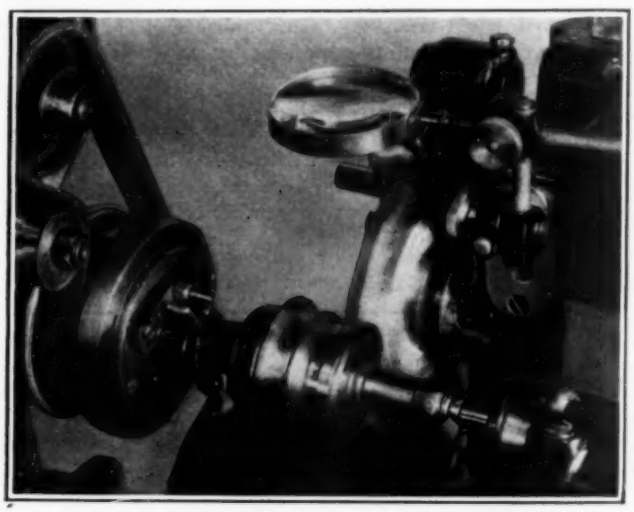


*Fig. 8—Form tools are ground by first dressing the grinding wheel to any part of the contour by means of the minutely measureable movements of which the machine is capable, and then by the same means transferring that part to the tool itself as it revolves before the wheel*

grinding wheel in the manner common to any cylindrical grinding operation. Suitably formed wheels are fed straight toward the work by the hand-operated cross-feed screw in what has come to be known as the "plunge" cut—that is, without traverse. The little traversing that may at times be necessary is done by hand, as the limits are too narrow to warrant engaging the power traverse with which the machine is provided.

Wheels used to grind the contours of form tools range in grade from I to M of the Norton scale, and in grain from 60 to 280; with 90 per cent of them within the narrower limits of K and L in grade and from 100 to

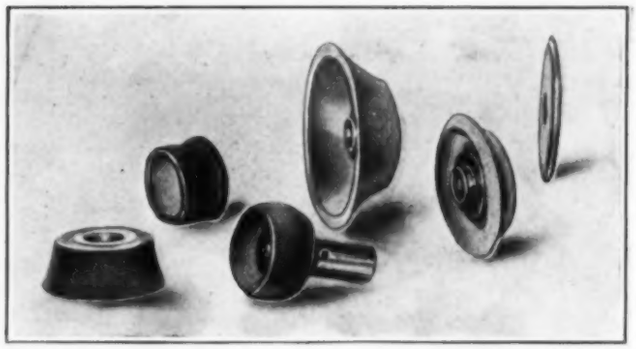


*Fig. 9—Although most of the wheels used to grind form-tool contours are disk wheels ⅛ in. and less in thickness, there are occasional forms that require wider ones. To grind them, cup wheels of various shapes and sizes are employed*

150 in grain. The coarser grained wheels are employed when cuts are wide and the softer grades are used for roughing. A roughing and a finishing cut are made over the contour of nearly all tools; the roughing cut leaving but about 0.002 in. to be taken off of the diameter with newly dressed wheels. On more than ordinarily difficult contours, or on tools requiring a special degree of accuracy, the number of cuts may be increased.

Fine-grained wheels of the harder grades are employed to make narrow channels and sharp corners. With a 280-M wheel, a right-angled corner can be ground to show not more than a 0.001-in. radius when magnified by a projectoscope. It is common practice to make corners sharp within a radius of 0.003 in. with a 150-L wheel.

The machine swings wheels 7 in. in diameter and ½ in. thick. As there are many single radii, angles, etc., wider than this it is customary to use cup wheels when widths greater than ½ in. are demanded. Some of the wheels are shown in Fig. 9, each mounted upon its own sleeve, or center, with flanges and nut. The hole in the sleeve fits the tapered end of the grinding machine spindle.

Wheels mounted upon individual sleeves may be returned to the machine as often as desired with reasonable assurance that they will run true, while if demounted from and then returned to a sleeve, the chances are that they would have to be re-formed each time they were used. It is not to be assumed, however, that it is safe to use a returned wheel for a finishing cut, even when mounted upon its own sleeve, without re-dressing, or at least testing, its form.

Most of the wheels used are of a special grade of aluminous oxide, procurable, however, from any maker of standard abrasive wheels. A few silicon carbide wheels are used. No rules for selection can be laid down other than the general one known to all grinding machine men, that aluminus oxide seems to work better on very hard materials and silicon carbide on softer ones.

The wheel at the right in Fig. 9 is of special interest, as it is the wheel used to sink very narrow channels in solid material. It is an aluminous oxide wheel, grade L, 150 grain. It has been dressed to a thickness of but 0.009 in. at the periphery—so thin that light shows plainly through it—yet it has been used many times to make channels 0.010 in. wide in high-speed steel. This width, however, is experimental—to find out what could be done.

Notwithstanding the variety shown in the illustration, the majority of wheels used for contour grinding are

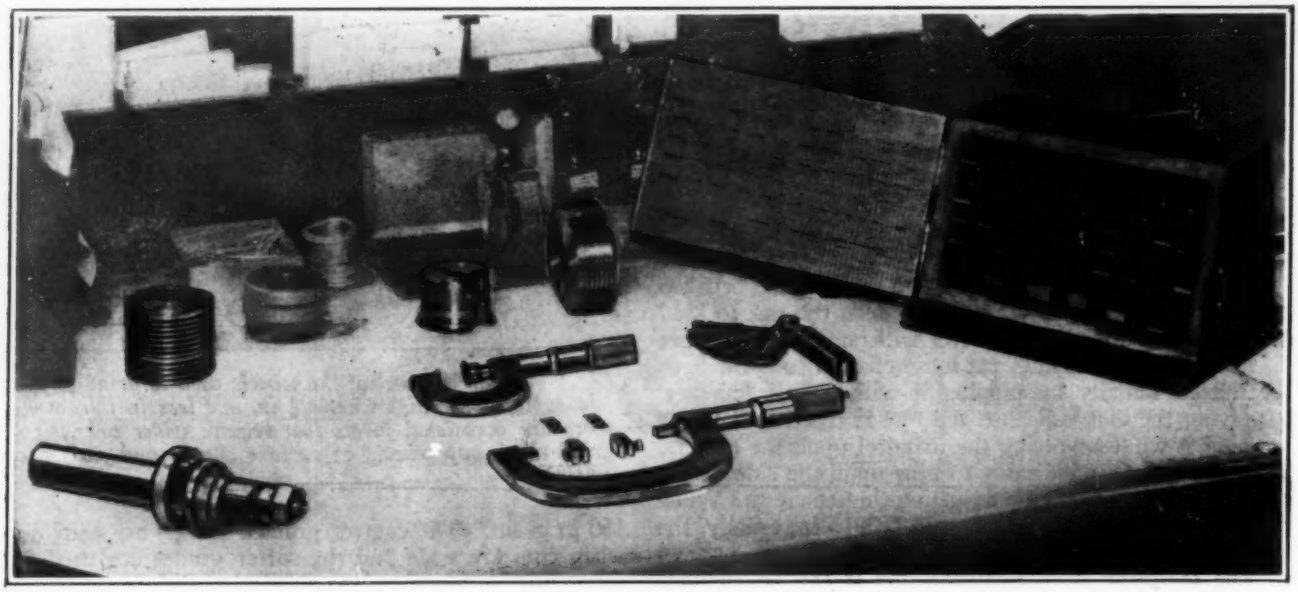


*Fig. 10—Though all of the movements of the machine are accurately determinable, the measurements are relative. To establish definite sizes it is necessary to employ micrometer calipers, gage blocks and thickness gages. The set of blocks here shown range from $\frac{1}{32}$ in. to $2\frac{1}{2}$ in. The micrometers have special measuring points*

disk wheels $\frac{1}{2}$ in. or less in thickness, many of them being but $\frac{1}{4}$ in. New wheels are 7 in. in diameter (except cup, or special, wheels) but they are usable down to 4 in. and smaller. Some plain disk wheels $\frac{3}{4}$ in. thick are used, but such wheels require special sleeves having the ends counterbored for the spindle nut of the machine.

The foregoing does not necessarily imply that a large number of wheels is required. Of course, in a department where several men are constantly engaged in making tools having a wide variety of contours, special wheels will accumulate rapidly, but in a small shop or toolroom where the variety of work is more restricted, a comparatively small number will suffice.

One wheel *can* be made to answer for many shapes by redressing it successively each time it is used, but such procedure would be false economy for the reason that it would entail undue waste. If the diversity of tool shapes in a shop is such as to demand many different angles, radii, etc., it will be cheaper in the long run to carry a fairly good supply of wheels.

Few special tools are required. In Fig. 10 may be seen a 1-in. micrometer fitted with sharp-edged disks on the measuring spindle and anvil; a 3-in. micrometer with flat anvil and measuring spindle, instead of the usual round parts, to measure diameters at the bottoms of narrow channels; and in the case to the right, a set of gage blocks ranging from $\frac{1}{32}$ to $2\frac{1}{2}$ in. to measure the widths of channels and to assist in setting the truing diamonds. There is also a thickness gage of the leaf type for very small measurements. By combining the gage blocks and the leaves of the thickness gage, any measurement within the limits may be obtained in thousandths.

The smaller micrometer is a standard tool with only the disks added. The increased area of contact surfaces makes it a safe tool with which to measure wheel thicknesses, and the thin disks enable the operator to reach narrow projections upon a wide tool that the micrometer without the disks would not compass because of the interference of the frame. The operators also have a way of taking advantage of the sharp edges of the disks to measure the widths of angular surfaces; a knack that will be considered later in connection with the application of the tools to the measurement of an actual contour.

The 3-in. micrometer is necessarily a special tool, and is so made that the measuring spindle does not revolve. With this tool may be seen a pair of extensions and some little clamps by which they can be attached to the spindle and anvil when desired. Their purpose is to measure relative diameters at the bottoms of channels less than $\frac{1}{32}$ in. wide, and the reason for their existence is that it was not considered advisable to make the measuring spindle and anvil of the micrometer so thin, as breakage would in that case involve an expensive repair.

The next article will show how the measuring features of the machine are employed to produce upon the grinding wheels the various forms specified by the drawings of the tools.

The metal working industries are intensely interested in *die casting.*

What are the possibilities? What metals are used? How large can die-cast parts be? How many cavities may be placed in a single die? What are the shrinkage problems? To what tolerances can the castings be made? What kinds of parts are die cast? How many can be made?

For the answers to these questions see *"Die-Casting Dies,"* next week.

# Meeting the Problems of the Contract Shop

By George S. Brady
*Associate Editor, American Machinist*

IT HAS been seen that the available equipment is one of the important limiting factors in the range of work that can be effectively handled by a contract shop, and that it takes constant alertness on the part of the management to keep the machines properly occupied so that there will be neither too much idle machine time nor too much setting aside of jobs to wait for empty machines. It is one of the outstanding points of distinction between the contract shop and the production plant where each machine has its regular line of work that can be scheduled more easily. Equal in importance, and possibly requiring more executive skill in handling, is the personnel of the contract shop. In a shop having a large proportion of highly skilled toolmakers a sufficient number of high-grade jobs must be on hand to keep these men going. Not only does it mean great loss of money to put skilled mechanics on routine work, but it also promotes dissatisfaction to give them what they may consider as boys' work. Furthermore, it is easy for a contract shop to develop a reputation for laying off men at irregular times instead of seeing in advance that its program is balanced. When this occurs it is difficult to hold a force of reliable men, and the continual unrest and uncertainty cannot be productive of good work.

**Free engineering advice, and goodwill jobs as "fillers," are recognized evils that are generally considered inevitable among contract shops, and they can be offset only by high efficiency and general skill in management as well as skill in workmen**

The class of work undertaken by the shop naturally determines the type of workmen required, but in no place is the need for all-round mechanics greater than in the average contract shop. In no place, moreover, is there need for greater shop loyalty and for a willingness on the part of the workman to attack each job with enthusiasm, seeking out new methods and looking to make a profit for the firm on every contract. The law of averages is a poor arrangement for a contract shop, and no shop can afford to have filler jobs that are net losses simply to keep the men occupied. The number of cases where free engineering service is given in the contract shop on prospective contracts that never mature is sometimes appalling, and it is enough to have the problem of averaging the cost of these over the accepted contracts without trying to make up for losses sustained on unprofitable jobs.

In the best regulated contract shops there is always some definite relation between the workman's time on the job and the cost. The closer this relation can be made the more interest the workman is likely to take in the work. In one large contract shop the time of an operation that is estimated by the foremen and supervisors in bidding on the job is put on the workman's shop card as the standard time. Although no bonus or other incentive wage system is used in the shop it is found that the man on the operation will take a lively interest in trying to make good on the estimate.

There is also a close relationship between the workman's time and the machine time, and right here is where too many contract shops lose proper balance by averaging machine time with the general overhead. If another workman is hired to help a mechanic his time is figured and charged hourly, yet when a machine whose value may be equivalent to 5 or 10 years of the workman's time is given to the mechanic as an aid, the contract shop manager often thinks it too much clerical work to give it an hourly rate. An $8,000 machine tool costs the contract shop approximately $1 an hour in actual "machine overhead," figuring depreciation and interest, and the running of the tool 50 per cent of the time, which is a fair average. This naturally should be added to the workman's time before general overhead is calculated.

A stable working force is a vital necessity for success in the contract shop. Where the turnover is permitted to reach a high percentage there cannot be the flexibility in adjusting the men to the various jobs, and in addition there is likely to be a sense of insecurity that will interfere with good work. The all-around skilled man, when he once becomes accustomed to the nature of the contracts taken in by the shop employing him, is able to adapt himself to a remarkable degree and to sympathize with the aims of the shop program. Among the successful contract shops it is stated repeatedly that the contract shop does not need an employment department, that the turnover should never be permitted to be large enough to require it, and that the managers should size up personally every man hired into the plant. This is certainly possible in most contract shops, as they usually do not exceed 100 employees.

Relatively few contract shops have what might be called an organized sales force, yet to obtain the balanced program that will permit the holding together of a stable working force requires organized sales effort. This effort can come through one or all of the channels described in a previous article, but in addition it ought to have the personal attention on the part of some one responsible

The third and last article of the series.

man in the management. In actual practice most managers of contract shops go over personally in detail every proposal for a job that enters the plant. The manager must have the moral ability to refuse a job if it does not fit in with the shop's program, and the shop will in the end gain more respect in the trade by such a procedure than if he took everything that came along. In order to minimize demoralizing fluctuations in the labor hours of the shop there should always be a good stock of orders ahead, and the relatively few contract shops in each center that are successful do have this excess work always on hand. The shops that have to resort to fitting in a "side line" such as the building of a machine tool that it is not in reality prepared to market, is grasping at straws, and is on dangerous ground. This, of course, does not refer to a shop that has found that it could develop a regular sale for a machine or product that it has made successfully on contract. By using sales appeal, keeping the name of the shop before the trade, and by personal attention to every job, the contract shop manager can keep in ordinary times sufficient jobs ahead so that his shop labor hours need not vary more than 10 per cent above or below normal any week. Such a fluctuation can readily be taken care of by overtime or by cleaning up on maintenance work. But fluctuations of 25 per cent, or higher, must inevitably result in hiring and laying off men, and are disastrous to shop morale. This principle applies the same whether the shop is a large special machinery plant with an organized sales department and big contracts, or a small heat-treating shop where the owner and two or three workmen turn over ten to fifty jobs a day.

### Materials to Be Kept in Stock

In the handling of materials, the contract shop that wants to keep on its toes faces one of its most serious problems. For any shop handling a variety of work it is not possible to standardize and stock raw materials. Some customers have definite ideas on what they require; and where one customer, for example, may order bronze bearings to be made of phosphor bronze another may insist on a bronze with high antimony. The majority of jobs, however, are taken in without definite specifications, and it is up to the contract shop to furnish a suitable material. If it is an intricate die and the contract shop figures on a non-shrinking steel that will produce a more accurate tool and give greater life, it may lose the contract on a price basis to another shop that uses a cheap steel and takes a chance on the hardening. Someone in the contract shop, therefore, must have a wide knowledge of materials, must be able to recommend the most suitable material, and must be salesman enough to "put it across" so as to help to land the contract, even at a higher price.

In the majority of cases it does not pay to stock materials, with the exception of certain standard steels for tools. Steels and other metals in bars and shapes are ordered in quantities only sufficient for the contract in hand, and charged directly against the job. Uusually 10 per cent is added to the purchase price of such material to cover handling and buying costs unless the customer purchases the material himself. The quantities are generally so small that the buying is done from a local jobber or wholesaler instead of directly from the mill. In the case of an occasional large order the jobber is still permitted to handle it in order to balance against his interest in the many small orders. At all times the contract shop must maintain quick and friendly access to a varied stock of materials such as is carried by the important dealers. This means friendly personal contact.

In regard to small tools used in the shop it is frequently thought in the small plant that it does not pay to have a tool storeroom or to systematize the handling and delivery. But good practice indicates that no shop is so small that it does not pay to have at least a boy to look after drills, cutters, lathe and planer tools, and other small equipment. It is found on investigation that the mechanics invariably horde and hide the small tools when they cannot be assured that such tools will be properly stored and served to them when needed. This results in unnecessarily large supplies in the shop, wastage, and lack of proper checking In the small shop an efficient toolroom clerk can see that the mechanics return the tools in a sharpened and usable shape so that they are ready for use when needed, and he can also keep track of the stores of bolts, nuts, washers, and other small supplies that must be on hand. It is the systematic attention to organization details of this kind that eliminates the confusion and lack of interest on the part of the workman that is found in many small and average sized contract shops, and makes it possible to develop the "flexibility" which is the pride of the all-around contract shop.

### Management Must Know the Business

A final important point in a general summary of the contract shop is that the contract shop itself must recognize the fact that the small or average-sized shop cannot support unproductive management overhead. Many of the smaller contract shops are "one-man shops," where the owner conducts all of the supervisory work beyond that taken care of by the foreman, even handling whatever sales, advertising, and accounting that are required. But such an arrangement does not provide for proper continuance of contracts when the manager is incapacitated, and a contract shop cannot be said to have begun to develop until some of the management responsibility is divided. However, every staff man in the contract shop is very generally a worker, and usually each executive is capable of following the work throughout the plant. This general knowledge of the business, and the direct supervision of the manufacturing details, inspires confidence and greater loyalty throughout the organization. Such a working staff safeguards the contracts from the customer's side, and makes it possible to have the personal contacts with customers that lead to repeat orders based on confidence without the formality of competitive bids. It also makes it easier to obtain and develop some product that the shop can manufacture profitably on a production basis, which is apparently the ultimate goal of the majority of contract shops.

## Operating a Plant Dining Room

AT THE plant of the Gleason Works, Rochester, it has been found possible to serve efficiently approximately 650 persons daily in the shop dining room within a period of about 15 minutes. This number constitutes 60 per cent of the working force, most of the remainder living in the vicinity of the plant. In order to handle the noon "rush" four lines are formed at one time. There are 13 regular employees in the dining room, with an additional 12 taken from the plant offices for serving at noon. There is ample seating capacity provided for 1,000 persons, to accommodate any special conditions. A regular meal consisting of soup, meat, vegetables, bread, dessert, and beverage, is given at a nominal price, or a variety of special dishes can be ordered.

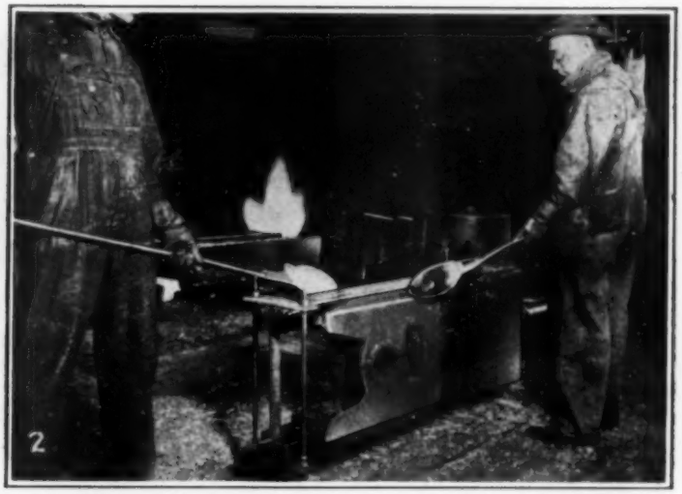


*Fig. 1—Pouring driving-box liners. Fig. 2—Babbitting crossheads*

# Railway Tools and Devices from a Southern Shop

By FRANK W. CURTIS
*Western Editor, American Machinist*

## Details of the locomotive shop and an outline of some of the work handled, including a babbitting fixture, a planing set-up and an efficient trepanning tool

ONE of the main repair points of the Southern Railway System is at Birmingham, Ala., and consists of a group of buildings suitably equipped to handle major repairs. The locomotive shop contains the machine, erecting and boiler departments, although the boiler department is in the form of a wing at one end of the main structure. The erecting shop has 24 pits of the transverse type that are served by a 150-ton overhead crane. The boiler shop has six transverse pits that lie parallel with those in the erecting department, and a modern machine layout arranged to accommodate heavy boiler repairs. This shop is served by a 40-ton crane. Running parallel with the erecting department is the machine shop, which is served by two 20-ton cranes. All machines are equipped with individual motor drive. A small building adjacent to the locomotive shop houses equipment for the pouring of liners and other brass work, and the babbitting of crossheads as well as miscellaneous operations of similar character. Such parts are transported by small cars over a narrow-gage track that leads between the two buildings, as shown in Fig. 1, which illustrates the pouring of a driving-box liner. The face of the driving box is built up by a sheet-metal trough to form the outer face of the liner when the brass is poured. The car has a revolving platform, so that, if necessary, the work can be revolved during the pouring. This feature is advantageous, especially in large work, and insures that the metal will flow uniformly to all portions.

Another operation carried out in the same building is illustrated in Fig. 2, showing the fixture used in connection with the babbitting of a crosshead. Two men pour the metal in one side, then the fixture is turned over enabling the opposite side to be completed. Constructional features of the fixture are shown in Fig. 3. The crosshead fits over a plug of the same taper as that of the end of the piston rod. The liner bars *A* are swung in place in the center of the guide faces and fastened by a strap clamp. Align-

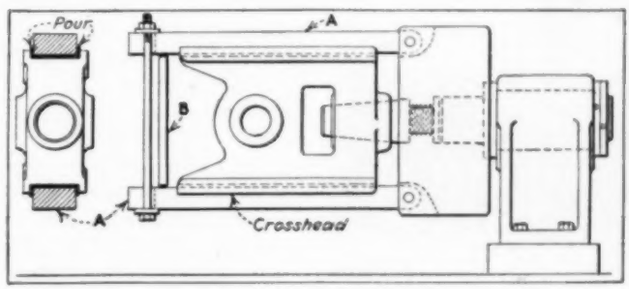



*Fig. 3—Constructional details of the crosshead babbitting fixture showing the method of mounting the work, the two liner bars in position, and the gage bar that spaces them to the distance between the guide bars on the locomotive*

The first part of the article. The conclusion will appear in an early issue.

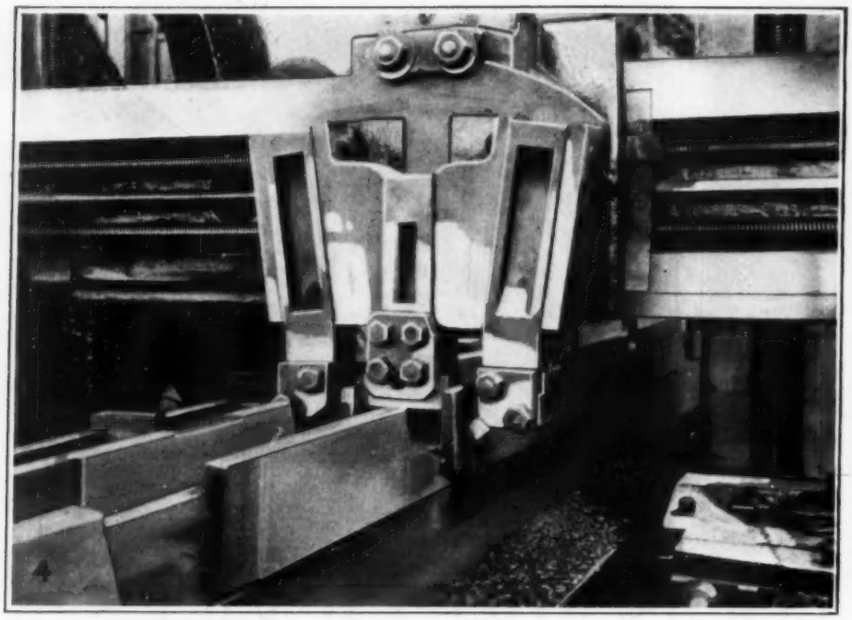


*Fig. 4—Shoes and wedges are machined in a planer provided with two fixtures, each accommodating nine pieces. Clamping of work is effected by a screw at the end of each fixture which connects with serrated blocks located between the pieces. Each toolhead has a broad-face and two straddle tools that machine the outer and inner surfaces of the work.*

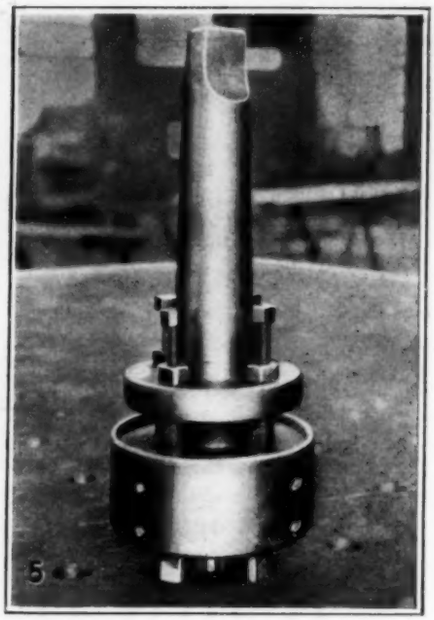


*Fig. 5—A trepanning tool having four adjustable cutters that can be set independently and which are held in place by headless setscrews. Lubricant is placed in a cavity in the body*

ment of the outer end is obtained by the gage bar *B*, which corresponds to the distance between the guide bars on the locomotive. At the left is shown the position of the liner bars in relation to the work.

Shoes and wedges are planed in gang form, using two fixtures, each of which holds nine pieces. The shoes or wedges are placed along the fixture, the end of the first one butting against a stop block. Blocks having serrations on the opposite sides are set between the ends of the shoes, or wedges, and the whole string is forced against the stop block by a screw and clamp at the opposite end. A portion of the set-up and one of the two toolheads used is illustrated in Fig. 4. The outer tools straddle the outsides of the work and the broad faced tool in the center finishes the jaw fit. The bottom face of the jaw fit, however, is roughed out first by a single-point tool in order to break the scale.

A flue-sheet trepanning tool used in the boiler shop is shown in Fig. 5. It has four adjustable cutters held in place by headless setscrews, and a pilot that enters the punched hole in the flue sheet. The upper portion of the body is made in the form of a reservoir enabling the cutting lubricant to be placed therein.

One of the home-made annealing furnaces used in the boiler shop is illustrated in Fig. 6. It is arranged with an air-operated door and four burners that distribute the heat uniformly throughout the chamber. Large sheets can be handled, preparatory to being formed.

*Fig. 6—A home-made furnace for annealing flue sheets and for heating sections requiring forming. It is equipped with an air-operated door controlled by a valve at the right-hand side, and has four burners, two on each side, so that the heat can be uniformly distributed*

## Strides in Foreman Training
### *Discussion*

By E. Andrews
*Manchester, England*

THE editorial on page 390, Vol. 68, of the *American Machinist*, is of more than passing interest. It is obviously the duty of every factory management to assist ambitious employees to reach the goal of executive leadership. Because foremen have already demonstrated certain qualities of leadership and because they form the direct connecting link between management and men, the training of foremen is undoubtedly one of the primary elements in the development of potential executives.

Many men are ordinarily promoted to the position of foremen because they have proven to be master workmen. They may have personalities which command respect and indicate leadership ability, but no definite training is given these men in the art of leadership. It is rather assumed that a man's experience in the shop and his ability as a master mechanic or machinist has fitted him for leading men. Untrained or unsympathetic foremen can completely destroy the good effects of any efforts to reduce manufacturing costs or improve quality of products. The foreman who is a leader will have a loyal following, and the workers will be with him rather than under him.

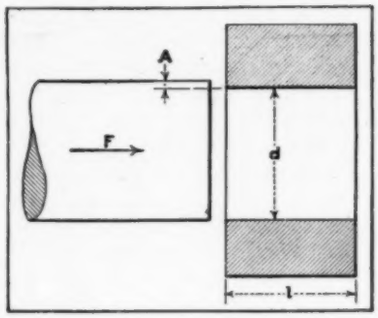



*Fig 1—Nomenclature diagram*

# RESEARCH on Force Fits

By N. N. SAWIN
*Research Engineer, Skoda Works, Czechoslovakia*

**Experiments indicate that the axial pressure necessary rises in direct proportion to the interference—The finer the finish of the surfaces the greater is the pressure required**

A SERIES of experiments was recently performed by the Skoda Works to determine the character of tight and force fits of the German (D.I.N.—*Deutsche Industrie Normen*) system and to establish the dependence of pressure on different factors. The apparatus consisted of taper arbors, one diameter of which was equal to the upper allowance limit and the other to the lower allowance limit; and steel and cast-iron rings, two of each length. One ring had a bore corresponding with the upper allowance limit, the other with the lower allowance limit for standard holes of the same class of finish.

The rings had lengths of $1d$, $2d$ and $3d$, $d$ being the nominal diameter, so that the relation between the pressure and the amount of contacting surface could be determined. With this apparatus it was possible to carry out actual tests on all possible combinations between the limiting dimensions of the pins and the rings. The clearances corresponding to tight-fit $F$ (festsitz), key-fit $T$ (treibsitz), and push-fit $S$ (schiebesitz) were checked, as were likewise the interferences for the proposed medium forcefits $L$ and heavy forcefits $LL$. The tests were carried out for nominal diameters of 8, 20, 40, 80, 100, 160 and 200 mm. Identical material was used up to and including 100 mm. in diameter. For larger sizes the rings were made of open-hearth steel, of the quality used for locomotive wheels, and the pins were of forged axle stock.

From the data obtained from these experiments it was possible to draw several conclusions. The first was that the axial force $F$ required to press a pin, Fig. 1, into a bore of diameter $d$ grows in the same ratio as the interference $A$, that is, to the difference in diameter of the pin and the ring, and also in proportion to the length of the bore $l$. As the nominal diameter is increased the force rises in a lesser proportion, and its rise is not the same for different ranges of diameter and for different materials.

When the interference is equal to zero, that is, when the pin diameter is exactly equal to the diameter of the bore, this force, of course, is not equal to zero. Accordingly, the following formula was developed for calculating the force of pressing:

$$F = a + bA$$

Where $a$ and $b$ are empirical factors depending upon the range of diameters and character of the materials, $A$ being the interference. The diagrams in Figs. 2 to 5 serve as proof. The curve at $M$, Fig. 2, shows that a tight fit (festsitz) in the D.I.N. system does not result in an actual tight fit if the bore is made according to the upper limit of tolerance. The cast-iron ring may be slipped on the ring 15 mm. without effort. In Figs. 2 and 3 the curves are divided into three parts: $AB$, $BC$ and $CD$. Part $AB$ corresponds with that part of the process during which the ring is slipped over the pin and the contact surface area is growing larger; part $BC$ with the pressing operation where the contact area remains constant, but where the interference grows constantly large; while part $CD$ shows the decrease in pressure due to reduction is the contact area. The straight-line law of dependence between force and interference is indicated by part $BC$. The diagrams are of different

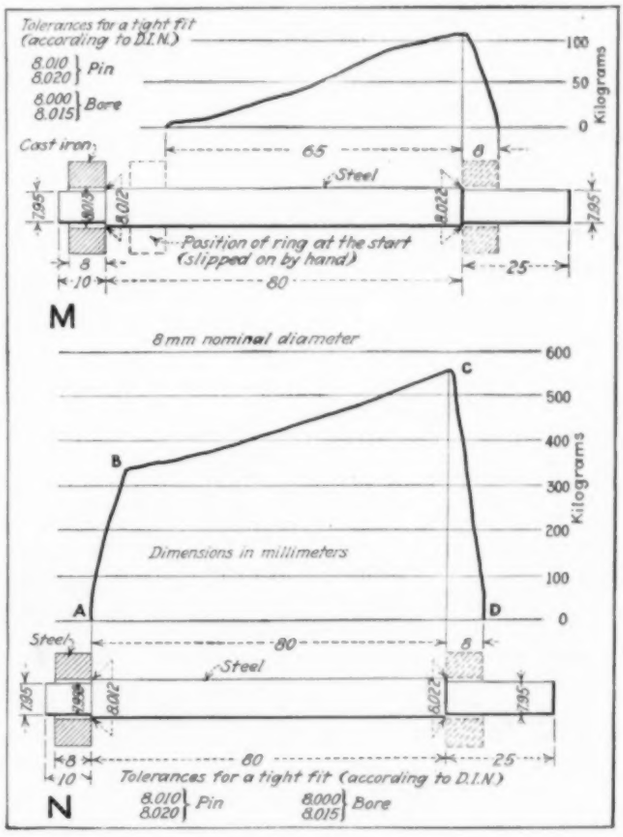



*Fig. 2—Pressure-interference curve for a cast-iron (M) and a steel ring (N) on a tapered shaft, 8 mm. diameter*

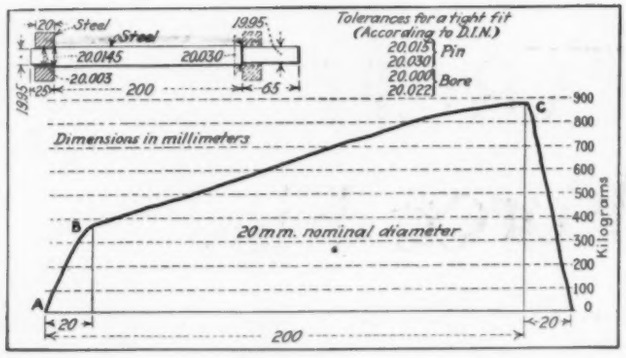



*Fig. 3—Pressure-interference curve for a 20-mm. shaft and steel ring*

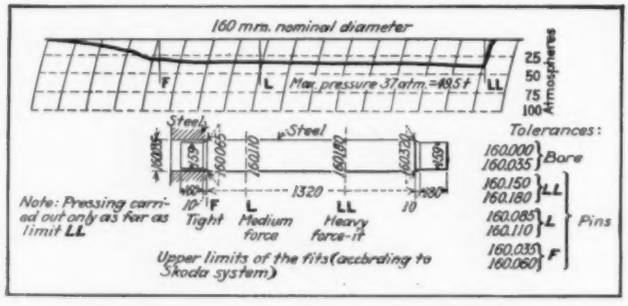



*Fig. 4—Pressure-interference curve for a 160-mm. shaft and steel ring*

types due to the fact that the experiments were carried out on different measuring machines.

In Fig. 6, the axial pressure required to push the ring along the shaft is shown as a function of the interference for two rings, both 40 mm. in diameter, but 40 and 120 mm. in length, respectively. The ordinates for the longer ring are in every case three times the length of the ordinates for the 40-mm. ring, and it is apparent that the pressures increase in the same ratio as the interferences and as the lengths of the rings.

The second conclusion reached was that the more exact the ground and polished finish of the surface, the larger the pressures required for a press fit. A rough-turned surface requires considerably less pressure than a ground one. Most likely the actual interference on a rough-turned surface does not correspond with the measured one, but is smaller. In addition, the actual contact area is smaller than the nominal area of the bore.

It was also observed that the pressure increases at a second pressing. If the pressing is repeated several times in succession, an increase of pressure will be observed, but the rate of increase will be smaller with each pressing. This law holds true only if the elastic limit has not been

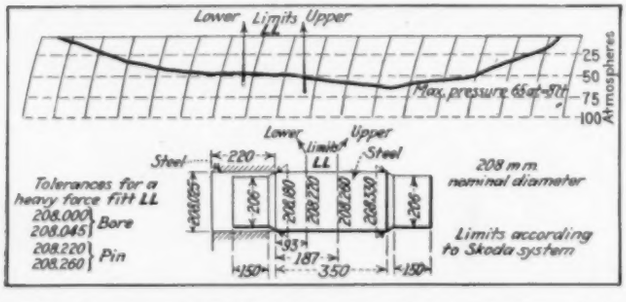



*Fig. 5—Pressure-interference curve for a 208-mm. shaft and steel ring*

exceeded, that is, if no permanent deformation has taken place. This increase is probably due to a smoothing-down of the contact surfaces and consequent increase in the actual contact area.

Out-of-roundness also has an important bearing upon the pressure. The pin as well as the ring are always elliptical to some extent and by chance the major axes of the ellipses may coincide or be at right angles to each other. In the second case the pressure will be greater than in the first, as has been confirmed by test.

Lubrication reduces the pressure, and the amount of reduction increases with increase in diameter of the pin and ring. Tests have shown that the reductions of pressure vary from 1 to 19 per cent for pins 8 mm. in diameter, and from 6 to 50 per cent for 40-mm. pins. Above 40 mm. the reduction is even more noticeable. In engineering books, the statement has often been made that lubrication will increase the pressure: this anomaly could be explained by assuming that the tests did not take into consideration the influence of other factors, such as finish of surface, imperfection of shape, change in surface after repeated press fits and the like.

Another factor that should be considered is the material of the parts to be assembled, as this has considerable

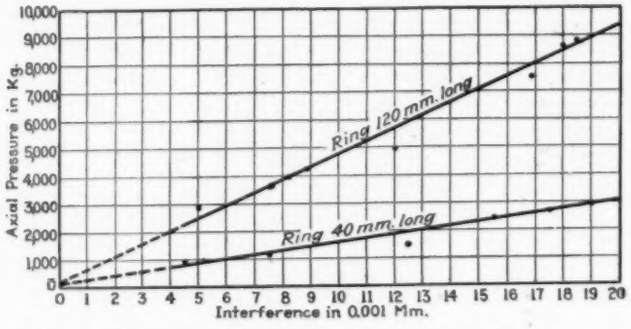



*Fig. 6—Effect of length of ring upon the axial pressure required for a force-fit*

influence on the pressure required for a force fit. Owing to the great diversity of constituents of various cast irons and steels it is difficult to set an exact pressure range for either of these materials. The results of tests indicate, however, that for average qualities of hardened steel and cast iron the required pressures are in the ratio of 1.7 to 1.0 approximately.

Heat-treatment has an obvious influence on the pressure required for a press fit and on the ability of the material to withstand repeated press fits. Hardened pins and rings, for example, will withstand repeated assembling and dismantling without any damage to the contact surfaces and without any change in their original dimensions. If no permanent deformation sets in, the strength of the assembly remains unimpaired, or increases. Material that has not been hardened will hardly withstand three-fold assembling by pressure; after that the contact surfaces will begin to "seize."

The required pressure is increased by increasing the thickness of the wall of the ring but not in direct proportion: For instance, doubling the wall thickness increases the pressure only about 20 to 30 per cent.

The factors enumerated above are only the more important ones: there are many others of a subordinate nature. However, the principal object of the tests (which was to check the D.I.N. system of force fits) was accomplished with sufficient exactness and completeness to produce results of immediate utility.

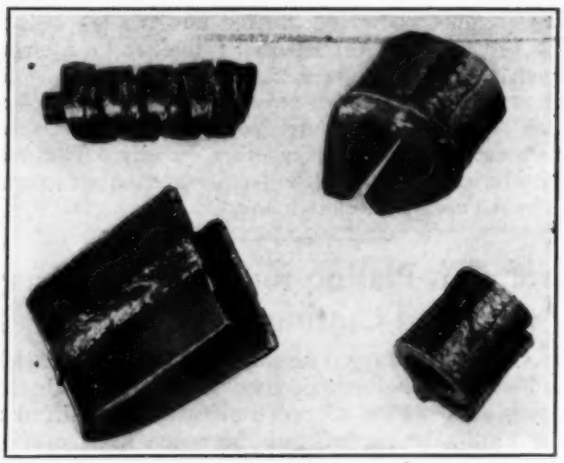
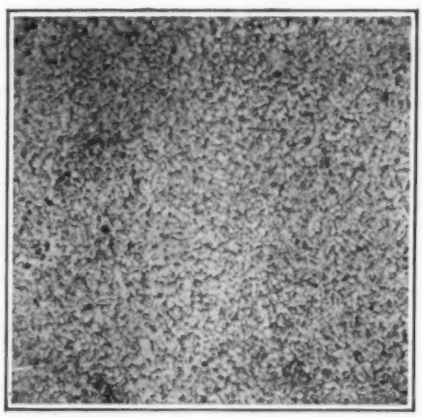


*Fig. 1—Demonstration of the ductility of welds made on the "Electronic Tornado" principle*

# A New Principle Applied to Carbon-Arc Welding

## Clean, Ductile Welds Produced by the "Electronic Tornado" Process

SEVERAL years ago research engineers of the Lincoln Electric Company experimented with a process of making ductile carbon-arc welds automatically, but it was only recently that the process was made commercially practical. The principle of operation was termed "Electronic Tornado" from the appearance of the arc, which resembles a whirling mass of electrons. One of the early machines in which a practical welding head using this principle was used, is shown with this article. In general the carbon electric arc is normally a difficult phenomena to control. It creates its own magnetic field, and in the passage of the welding current through the parts being joined, creates other magnetic fields of variable direction. The arc, therefore, tends to wander about seeking the path of least resistance between its own magnetic field, produced by the passage of welding current, and the piece being welded. In extreme cases, the arc is actually blown out by this magnetic effect. In the construction of the electronic tornado head, by super-imposing a strong magnetic field on the arc flame, a control of the arc is established. This control permits the arc to travel through the variable fields without disturbance. The arc is given a gyratory motion of high velocity by rotating the carbon mechanically and this motion also tends to hold the arc in a straight line. As a result the crater is centered directly below the rod where the heat is concentrated. Oxidation is another effect which is extremely detrimental to successful welding, and unless some means are taken to prevent it, a high percentage of oxide inclusions will be found in a weld when examined under the microscope. In the electrotonic tornado head, as commercially applied, a flux that forms carbon monoxide gas is mechanically fed into the crater in the form of a ribbon, or rope, suitably treated. At the high temperature of the arc this gas immediately burns to carbon dioxide with a characteristic blue flame, so that the operator is unaffected by this gas. The active part of the weld, however, is completely inclosed in an atmosphere of carbon monoxide, an active deoxidizer. Uniformity in the weld is obtained by two methods: mechanical feed of the work at a



Magnification 100 times

*Fig. 2—Microphotograph showing the crystal structure of the weld*

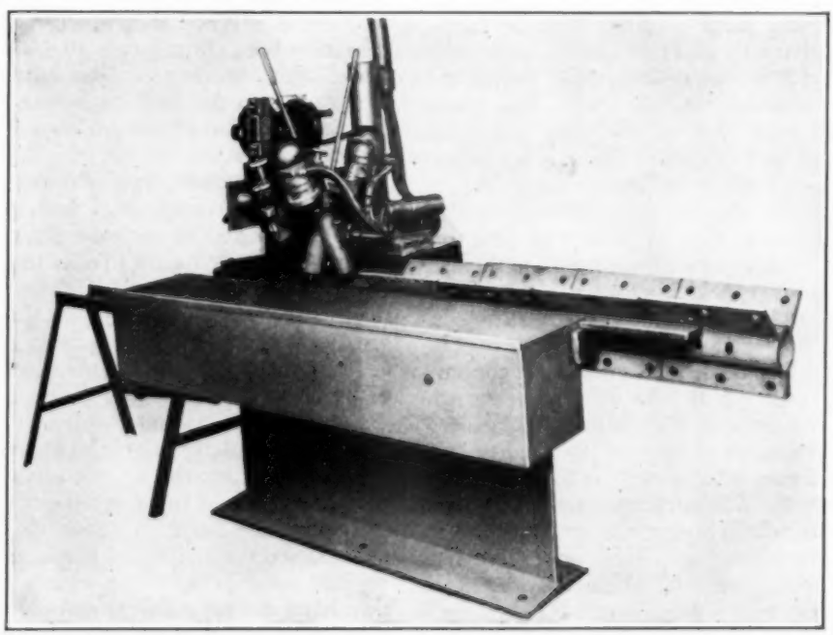


*Fig. 3—Electronic tornado welding machine for welding oil derrick clamps*

uniform rate, and automatic control of the length of arc. This control is effected through a mechanical feed similar in principle to the control of the carbon of an arc lamp. Response is to variations in voltage of the arc, and the carbon is fed in or out automatically to compensate for changes in voltage across the arc due to unevenness of the material being welded and to consumption of the carbon itself. As long as the rod is not in physical contact with the weld, no carbon is absorbed by the steel. In fact, some is lost due to the presence of the deoxidizing agent.

To sum up, therefore, the electronic tornado head consists of the apparatus necessary to rotate the carbon rod, feed it automatically, feed the fluxing material, and to create a strong magnetic field about the arc. This field is such that it is weak in the center of the arc but becomes stronger as the arc departs from the geometric axis of the rod. Hence the arc tends to maintain a centered position of equilibrium.

The ductility of the resulting weld is demonstrated by the test pieces shown in Fig. 1. The spiral piece in

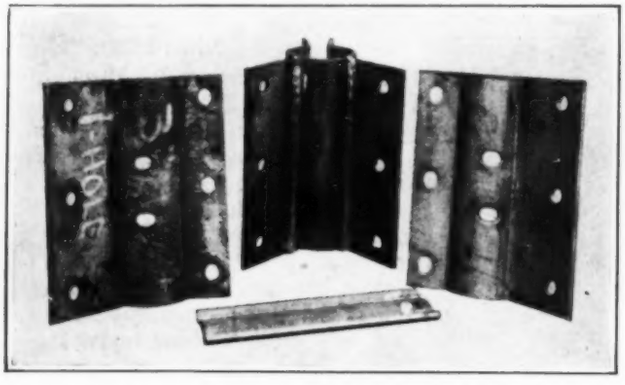


*Fig. 4—The finished derrick clamp shown in the center is made from the other three pieces by the electronic tornado welding process without the use of filler rod*

the upper left-hand corner of this illustration is the welded portion that had been cut out of two plates that had been butt-welded together. As can be seen, the strip was wound about a piece of pipe. Similar strips, also cold, were twisted axially and tied into knots without fracturing. In Fig. 2 a microphotograph shows the refining effect of an electronic tornado weld. The crystal structure is identical with that of the steel plate, the grains being small and well defined. There is no indication of burning, nor are there oxide inclusions.

The application of the electronic tornado to a commercial machine is shown in Fig. 3. It will be seen that there are two of the new type welding heads with their electrode holders crossing each other at a sharp angle. This construction is of interest because, with an uncontrolled arc, it would be practically impossible to operate two flames in such close proximity, as one would continually blow the other out. With the electronic tornado head, however, the two arcs do not conflict.

This automatic welder was designed to produce oil-well tubular derrick corner clamps such as the one shown in the center of Fig. 4. These clamps are made from three pieces of plate whose aggregate radius bending totals a complete circumference. These pieces are first placed in an assembling machine where they are tack welded by an operator with a hand torch. The various pieces are then closed about a mandrel and held in position by air clamps.

The caps thus assembled are fed into the big welder and are progressively carried under the arc by a chain on which there are dogs set at proper intervals. In this automatic welder, welds are made at the rate of over 40 ft. an hour for each head. No filler rod is used; the arc fuses the various plates together directly. The machine itself was built entirely from standard structural shapes by the use of the electric arc.

## Chromium Plating for Wearing Parts and Cutting Edges

CHROMIUM plating is finding its way into new fields and seems to be making good in a variety of uses. Beginning as a plating to prevent rust and to afford a pleasing finish, the hardness of chromium itself opened new fields of usefulness. Worn gages were built up to size by a deposit of chromium and, because of the superior wearing qualities of these gages, new gages were made to allow for a plating of chromium so as to secure the same advantages.

Perhaps the largest single use of chromium plating today is that of coating piston-pins for automobile engines so as to increase the life of the pins in service. In this case the pins are hardened, ground and lapped before plating, the plating requiring but a very short immersion in the bath. This is done automatically and the coating is about 0.0001 in. thick on each side. The pin is first hardened because it is necessary to support the thin wall of chromium by a strong metal if it is to stand up in service. Radiator shells, lamp trimmings and other parts are being plated with chromium instead of nickel because of its rust- and stain-resisting qualities.

### Use on Cutting Tools

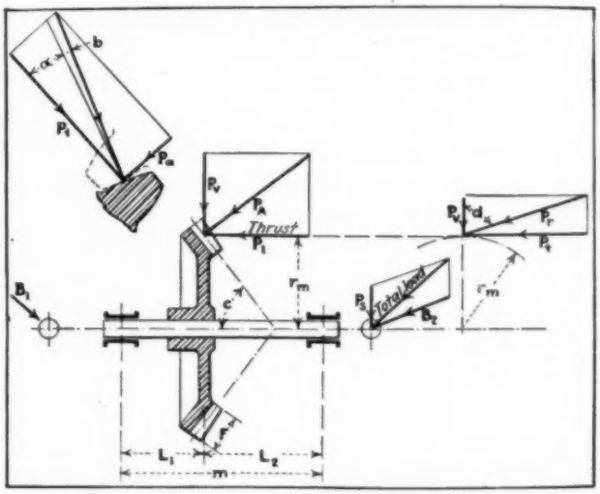
Chromium plating is also being used on cutting tools to a greater extent than is realized. On knives or dies used in cutting paper and leather the chromium plating is reported to add greatly to the life between grindings. In shearing knives, the plating is on the side of the knife and the grinding is done on the edge so that the chromium remains in service indefinitely. The same is true in milling cutters. In one shop where formed gear cutters and hobs have been chromium plated, the life is given as from 3 to 5 times the life of plain cutters. Here the cutters are ground on the face, as is usual with formed cutters, and the hard skin of chromium remains on the outside of the tooth form.

Drills also have been chromium plated with good results and in micrometers both the anvils and screws have been plated to increase the resistance to wear and so lengthen their useful life. Plungers for use in Diesel engines are being plated with a coat about 0.0100-in. thick and the plungers then ground to size, adding greatly to their length of service. Large pump builders are also using chromium plate to add to the wear life of parts.

Spindles for machine tools also have been chromium plated, particularly for bringing them up to size after wear or when ground a trifle small. Here too the plated portion is ground to secure the correct size. Other uses for chromium plate in which its hardness resists wear and maintains its size and shape, is on calender rolls and similar parts. Backed up with a strong, hard metal, its own hardness resists wear and abrasion to an astonishing degree. It is also believed that cylinder bores can be chromium plated to advantage in many cases.

# Bearing Load Calculations for Gears

## Helical and Worm Gears




### Straight Bevel Gears

$F$ = face of gear teeth in inches
$c$ = pitch cone angle

$T = \dfrac{63{,}025 \times \text{hp.}}{\text{r.p.m.}}$ = torque in shaft in inch pounds

$r_m = r - \dfrac{F}{3} \sin c$ = mean radius of pitch circle

$P_t = \dfrac{T}{r_m}$ = tangential component of tooth pressure

$P_a = P_t \times \tan (a + b)$ = angular thrust component of tooth pressure in pounds

$P_v = P_a \times \cos c$ = vertical component of angular thrust in pounds

$P_l = P_a \times \sin c$ = lateral component of angular thrust in pounds

$P_r = \sqrt{P_t^2 + P_v^2}$ = resultant radial load on the gear in pounds

$P_l =$ = thrust load on bearing in pounds

The load on each bearing is then found as in the case of a spur gear, $B_1$ representing the load on the nearer bearing.

There is also an additional load on the bearings, $P_s$, caused by a tilting action of the force $P_l$. Its value may be found by dividing the product of the lateral component and the mean pitch radius by the distance between the bearings. The angle $d$, or direction in which the resultant radial load acts is determined by the following equation:

$$\frac{P_v}{P_r} \cos d$$

Taking the additional load into consideration the total radial loads in pounds on each bearing will be

$\sqrt{B_1^2 + P_s^2 + 2 \times B_1 \times P_s \times \cos d}$ for the nearest bearing

$\sqrt{B_2^2 + P_s^2 - 2 \times B_2 \times P_s \times \cos d}$ for the farthest bearing

### Helical Gears

$r$ = radius of pitch circle in inches
$a$ = pressure angle of the gear teeth
$b$ = friction angle of the gear teeth
$c$ = helix angle of the gear teeth

$T = \dfrac{63{,}025 \times \text{hp.}}{\text{r.p.m.}}$ = torque in shaft in inch pounds

$P_t = \dfrac{T}{r}$ = tangential vertical component of the tooth pressure in pounds at the pitch line

$P_v = \dfrac{P}{\cos (a + b)}$ = resulting vertical component

$P_l = P_v \times \tan c$ = resulting lateral component or thrust

$B_1 = \dfrac{P_v \times L_2}{m}$ = radial load in pounds on nearest bearing

$B_2 = \dfrac{P_v \times L_1}{m}$ = radial load in pounds on farthest bearing

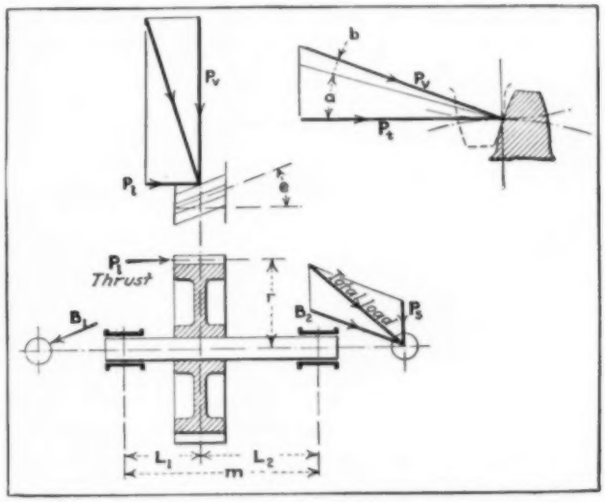
In addition there is the twisting force due to the lateral component, the value of which is as follows:

$$P_s = \frac{P_l \times r}{m}$$

The total radial loads in pounds on each bearing will then be:

$\sqrt{B_1^2 + P_s^2 + 2B_1 \times P_s \times \sin (a + b)}$ for the near bearing

$\sqrt{B_1^2 + P_s^2 + 2B_2 \times P_s \times \sin (a + b)}$ for the far bearing




Submitted by S. C. Martin.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American Machinist

*Editors:* KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

## *Good Advice on Selling That Probably Will Not Be Followed*

QUALITY, service and delivery have not lost all of their punch. It still is possible to sell on the basis of these three instead of price, according to instances coming to light now and then.

Perhaps more courage in refusing orders is needed to combat the buyer's insistence upon getting overmuch for his money. In theory, at least, a protracted refusal of orders by a large group would force the offer of orders at high price after the low-priced plants could no longer quote satisfactory delivery.

Given enough business at a loss the low-pricer will soon discover the dissatisfaction of doing business for nothing. He will then raise his prices, or sacrifice one or more of quality, service and delivery. He may sacrifice all of them. No matter what he does, he plays into the hands of the high-pricer who refuses to work for nothing.

Low prices that pass on to the consumer part of the savings made by improved methods, modern equipment and invention are a part of good business economics. Profitless prices, quoted just to get the business from competitors, are harmful to the prosperity of individual, manufacturer, industry, and country. When it gets down to a case of no profit by selling on price alone, the manufacturer is likely to try selling on quality, service and delivery. He will do better if he tries such selling some little time before he is forced into that position.

## *The Heavy Toll of Shop Executives*

SAFETY campaigns have done much to reduce the number of physical accidents in the modern shop. And workmen's compensation helps materially in preventing the financial distress that formerly followed such accidents. But modern high production methods exact a heavy toll of those responsible for their operation and success.

We can all make up quite a formidable list of those who have broken down under the strain of new production programs and who, as a result, have either been obliged to retire or have joined the great majority. These men are just as much industrial casualties as though they had been killed in a shop accident.

Unfortunately, too few general managers appreciate the problems of the production engineer. Special machinery must frequently be devised or regular equipment adapted for more rapid production. Men must be trained, coaxed to maximum production regardless of weather or discomfort, and made to behave as nearly like human beings as possible. Failures of either men or machines are not a valid excuse for failure to meet production schedules.

There is sometimes the added strain of jealousy and the discord of petty plant politics. Changes of management and policies are often made with startling rapidity. They all affect the production man and add to his burdens. He needs, perhaps more than any other executive, change and relaxation. But golf and similar diversions are not for him. And when he breaks, perhaps just before he attains his goal, he is discredited and the new man is hailed as a success.

The production engineer is seldom sufficiently appreciated. Yet without him we should not have attained our present place in the manufacturing world. He deserves consideration that will enable him to conserve his health and enjoy the fruits of his labors.

## *Need of Ethics in Buying*

THERE is a tendency on the part of purchasing agents to give the seller more consideration than formerly, even in a buyer's market. It is being realized that adequate sources of supply are about as important as prices and that in order to be reliable a concern must be profitable to its owners. Demanding a fair profit is more legitimate than pretending to, or actually doing business without it.

In some lines, however, those in charge of purchases have not yet learned that a code of business ethics exists. This is particularly true in some government departments. And there is reason to believe that the transgressions are more the result of ignorance of business practices and ethics, than unfair intention. The frequent shifting of men from department to department makes for instability in purchasing, due to a lack of business training on the part of the new men.

It is suggested that attention to business ethics in the schooling and training of all men in government service would be beneficial to all concerned.

# Norton 12x36-Inch Multi-Purpose Grinding Machine

SIMPLICITY of construction and complete power control within itself are features of this improved 12x36-in. multi-purpose grinding machine which has been announced by the Norton Company, Worcester, Mass. Designed as an intermediate tool between the tool grinder and the heavy production machine, it permits the handling of small lots of pieces too heavy for the tool grinder and not of sufficient quantity to warrant the employment of a production machine. Its range includes external, internal, and face grinding.

This grinding machine is self-contained and eliminates the necessity for overhead shafting. Three separate motors drive the headstock, wheel, and the work table and pump. The wheel drive is from a motor mounted on the wheelslide, the table drive is from a backshaft driven by a motor directly on the rear of the machine, and the work drive is by a motor mounted on the headstock. Each motor is a separate unit, and is individually controlled. A generator operated by the table-traverse motor may be provided for the work-drive motor where d.c. is not available. By the use of these three motors, complicated gearing, shafting, and belting have been eliminated within the machine. All the important mechanisms are on the outside and are easily accessible. This construction reduces to a minimum the care necessary.

Though essentially a light machine, it is rigidly built and will swing work up to 14 in. in diam. or grind pieces up to 37 in. in length. The construction of the headstock and wheelhead permits grinding a variety of work.

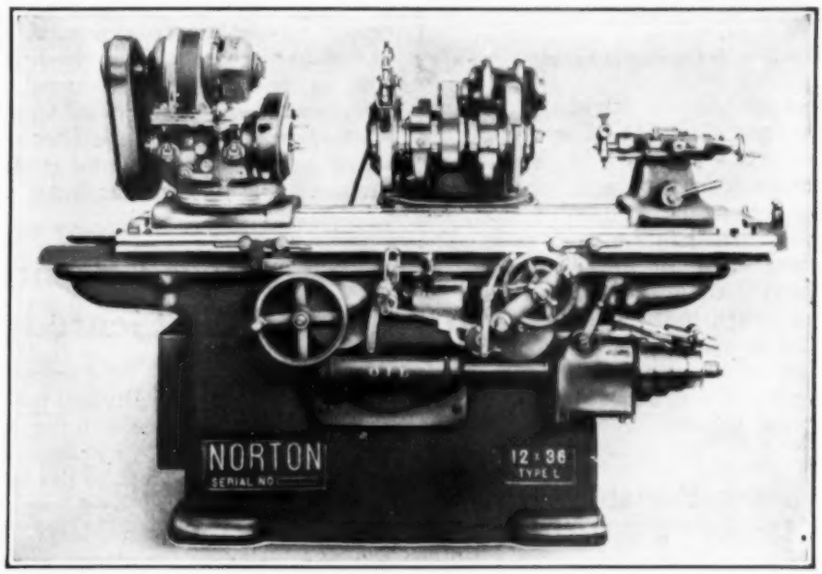



*Fig. 1—Operating side of Norton 12x36-Inch Multi-Purpose Grinder showing the centralized controls*

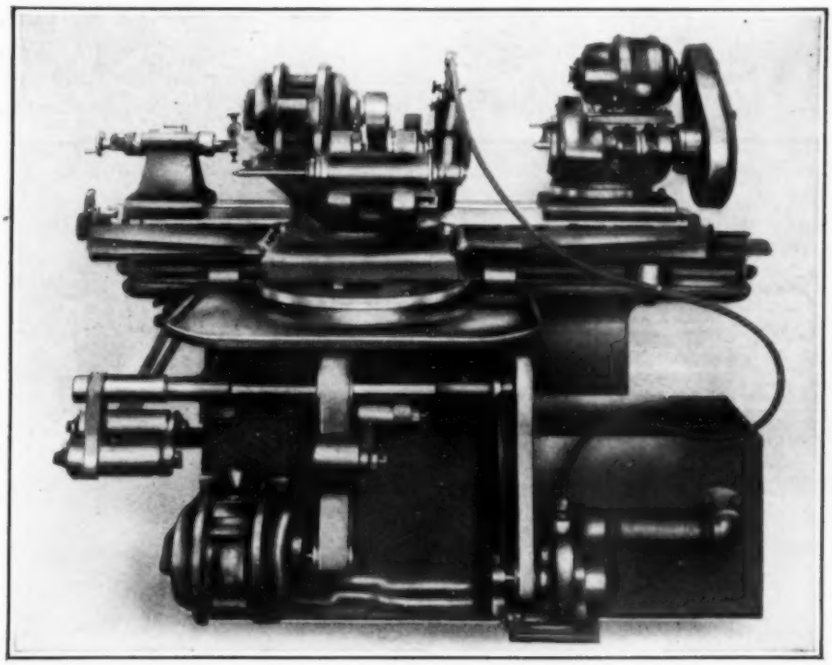


*Fig. 2—Rear view of the grinding machine showing details of the various drives*

Both the headstock and the wheelhead are of the swivel type and are graduated on the base in degrees. Positions on the headstock are provided for face grinding. The wheel head may be swiveled to an angle of 180 deg., to bring into position the internal-grinding spindle, which is mounted continuously on the double-ended wheelhead. Intermediate positions for external, angular grinding are also possible. The headstock is equipped with a chuck which may be attached to the spindle to handle small work which cannot be handled on centers. Provision is made so that the centers may be live or dead for plain cylindrical grinding.

The footstock is of the combination lever and screw type for quick changing of work on centers. A diamond tool holder is also provided. The work table is made in two parts, the top pivoting on a stud in the center so that it may be clamped at both ends. The table is graduated in degrees for taper grinding and also in

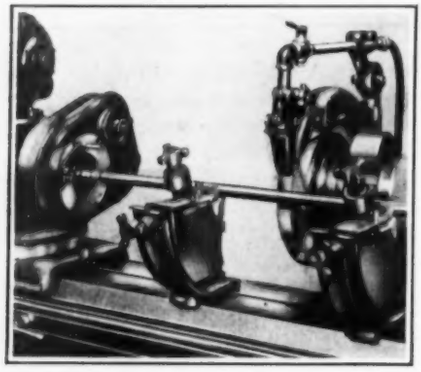


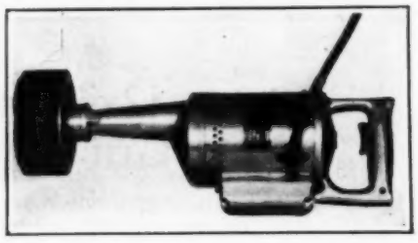
*Fig. 3—Close-up of the centers and rests*

feet per minute. Eight speeds, ranging from 21 to 111 in. per minute are available. The wheel feed, either automatic or by hand, operates regardless of the position of the cross-slide relative to the work table. The wheel may be fed at any angle at any time. An automatic stop arrests the feed when the work is to size. The reverse mechanism is the same as is used on all Norton cylindrical grinding machines and is made for accurate grinding close to shoulders.

## Clark Portable Grinder and "Jiffy" Wheel

Abrasive grinding, sanding, hand buffing, wire brushing, disk sanding, and saw gumming are operations that may be performed with this portable hand grinder manufactured by the Jas. Clark, Jr., Electric Co., Louisville, Ky. The machine has a ventilated housing made from aluminum alloy. The motor has a 40-deg. rating and is mounted in ball bearings. All gears are made from a special alloy steel, heat-treated. The current is controlled by an automatic double-pole switch with a locking device. The unit is supplied in three sizes, Nos. 00, 0, and 1, which give speeds of 5,000, 4,000, and 3,000 r.p.m., respectively.

The "Jiffy" sanding wheel, as its name implies, is made so that the clamps may be knocked-down quickly to remove old bands. The wheel consists of two clamps constructed of aluminum alloy, and machined so that when clamped together the filler and abrasive bands form a true cutting surface. The rubber filler bands are



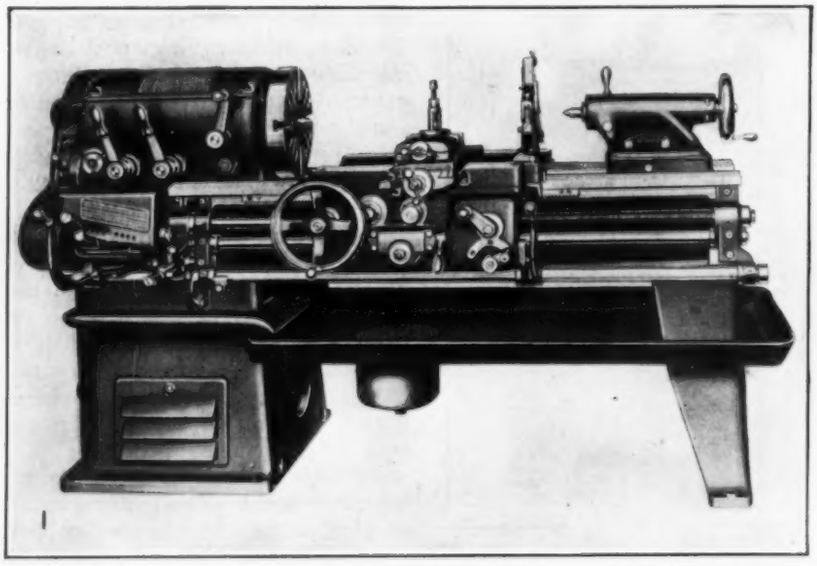
*Clark Portable Hand Grinder shown with "Jiffy" sanding wheel mounted thereon*

flexible and will not expand under centrifugal force nor puncture. They are made in widths of 1½, 2, and 3 in., for wheels 4, 5, and 6 in. in diam. The abrasive bands are made of endless linen cloth coated with Nos. 24-30-36-40-50-60 and 80 grit.

## Reed-Prentice Heavy-Duty Geared-Head Lathe

A GEARED-HEAD lathe designed to combine the rigidity and power of a production machine with the versatility and ease of manipulation requisite to a toolroom lathe has been brought out by the Reed-Prentice Corporation, Worcester, Mass., and is now available to the market in two sizes to swing work 14 and 16 in. in diam., respectively. It will be made with various lengths of bed. The present model, shown in Fig. 1, is made with a 6-ft. bed, to take work 31½-in. long between centers.

A 3-hp. electric motor in the cabinet leg is mounted upon a hinged bracket that is provided at the free end with an adjusting screw and nut by which proper tension can be maintained upon the belt or silent chain used. Power is delivered to a constant-speed pulley mounted upon the first shaft of the headstock and engaging that shaft through a "Twin-Disc" clutch. Removable covers on the side of the cabinet leg permit easy access to the motor, and the latter may easily be removed from its position without disturbing any other part of the machine. The belt or chain is



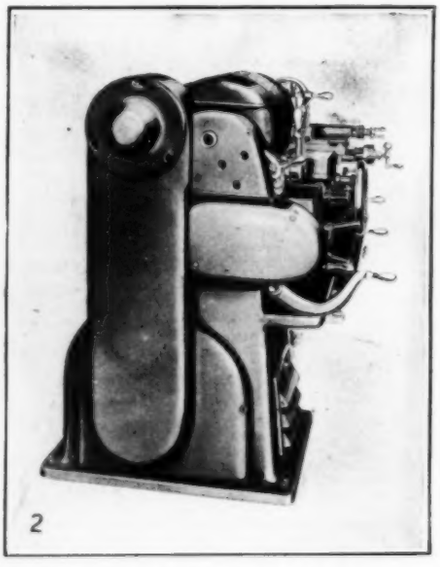




***Fig. 1—Reed-Prentice Heavy-Duty, Geared-Head Lathe. Fig. 2—End view of the lathe with the guards in place***

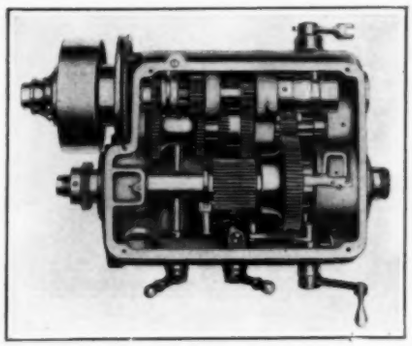


*Fig. 3—View of the selective gear box*

fully inclosed by the guards as shown.

Either of two hand levers on the front of the machine, one at the left end immediately below the quick-change gear bank and the other to the right of and traveling with the carriage apron, engage and disengage the double-disk clutch to start and stop the machine. A reverse movement of either lever applies a brake to bring the spindle quickly to rest.

In the headstock are nine gears, shown in Fig. 3, through which eight changes of speed are obtainable. The speeds range from 18 to 432 r.p.m. in geometric progression. The selection is made by three interlocking levers on the front of the headstock.

The gears in the driving train are of chrome-nickel, heat-treated steel. The teeth of these gears are burnished before, and lapped after they are hardened. The selective gears slide on heat-treated chrome-nickel shafts, six splined, and the teeth are rounded for easy engagement. All gear shafts in the head are carried on ball bearings. The case is used as a reservoir to contain lubricating oil, the level of which is indicated by a glass gage in the front wall. The level is maintained so that the lower portions of the several gears will pass through the oil and distribute it by splash to the bearings.

The spindle is also of heat-treated, chrome-nickel steel, and is carried on two pairs of Timken tapered roller bearings as shown in Fig. 4. The main bearing is adjusted by tension to sustain the end thrust upon the spindle, and the rear bearing is supported by a floating case to compensate for slight variations in length of spindle resulting from temperature changes. The diameter of the spindle-nose is $2\frac{3}{4}$ in., and it has a 4-pitch thread for attaching chucks and face-plates. The through hole is $1\frac{1}{4}$ in. in diameter and the front end is tapered to receive a No. 4 Morse shank.

The tailstock is provided with two clamping bolts, and is of set-over construction to permit the turning of tapers without the use of taper attachments. The tail spindle is $2\frac{1}{4}$ in. in diameter. The spindle-binder is on one side of the barrel instead of on top, and is so designed as to bind the spindle without affecting the alignment of the centers.

Manganese-alloy steel gears in the inclosed quick-change gear box provide 41 changes of feeds and threads ranging from 0.0035 to 0.112 in. per revolution of the spindle, and from 3 to 96 pitch, respectively. The feed rod is separate from the lead screw, and interlocking levers prevent simultaneous engagement of feeds and threads. A slip-pinion in the apron disengages the carriage from the rack to allow the handwheel to remain idle when cutting threads. End thrust upon the leadscrew is sustained at both ends of the latter by bronze thrust washers between hardened-steel collars. The leadscrew is $1\frac{7}{16}$ in. in diameter, with 4-pitch Acme thread. It is carried upon ball bearings.

The carriage has a bearing $25\frac{1}{2}$ in. long upon the ways. The apron is of box construction, with a reservoir to hold oil for lubricating the gears and bearings. All gears are of 0.45-0.50 carbon steel, bronze-bushed and carried upon studs that are supported at both ends. A double-disk clutch engages either cross or longitudinal feeds through a single lever with interlock to prevent simultaneous engagement. All feeds reverse in the apron.

An adjustable knock-out on the feed rod can be set to disengage the feed at any predetermined point. A threading dial at the right end of the front carriage wing enables the operator to disengage the lock-nut at will and re-engage it in proper relation to the thread being cut. The spindle does not reverse. The cross-slide is provided with a compound rest, adjustable to any angle.

The net weights of the two machines are 2,450 and 2,675 lb., respectively. Either machine covers approximately 40x84 in. of floor space.

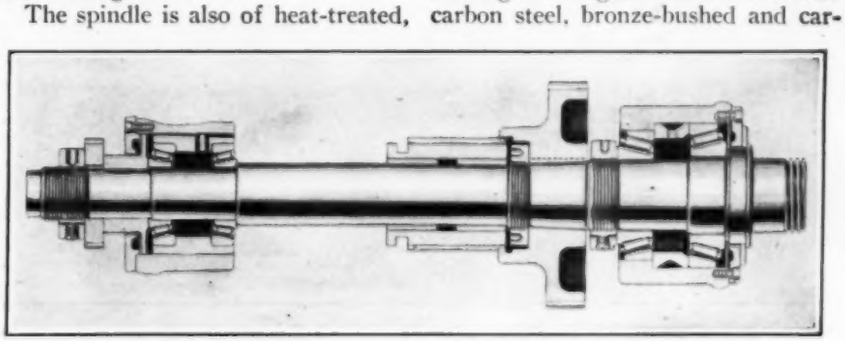
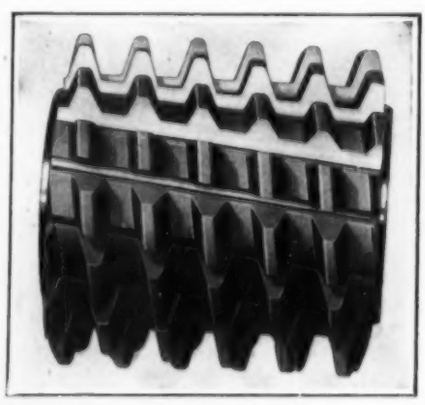


*Fig. 4—Cross-section of the spindle assembly*

## Illinois Tool Works "Shear Cut" Hobs

Roughing of spur gears may be performed quickly and easily by the use of "Shear Cut" hobs, which have been developed by the Illinois Tool Works, 2501 North Keeler Ave., Chicago, Illinois. These hobs have a shearing action, and are shown in the accompanying cut.

The helical gashes in this hob have the same hand helix as that of the thread. This is contrary to common practice in standard hobs, in which the gashes are cut at right angles to the thread.



*Illinois Tool Works "Shear Cut" Hob*

The construction of the Shear Cut hob provides a leading acute cutting edge, a shearing top cutting edge, and an obtuse leaving cutting edge in each tooth in the hob. The gashes are

also undercut. Due to certain modifications of the lead and pressure angles of the hob teeth, the greater portion of the work is distributed on the acute and the shearing cutting edges, and a comparatively small portion is left for the obtuse cutting edge.

The cutting action of the hob teeth in the Shear Cut hob permits a greater feed than is usual. This puts less wear on the cutting edges.

## Federal Miter Butt-Welder

MITER welding of steel sash and similar forms on a production basis is made possible by this No. 60 automatic butt-welder which has been developed by the Federal Machine & Welder Company, Warren, Ohio. The machine embodies the Federal "flash proof" principle and is equipped with a 65-kw. transformer and an auto coil which provides 60 per cent voltage regulation. The welder is shown in Fig. 1. The clamping and releasing of the work as well as the starting of the motor is done by means of foot levers. A mechanical brake stops all motion at the end of the welding cycle. As shown, the machine will weld an area of about one square inch. It can be adapted to larger cross-sectional areas by increasing the transformer capacity. As geared, this machine requires 7 sec. for the welding cycle. To this, time for clamping and releasing the work must be added. In practice an average speed of 240 welds per hour is attained, but this will vary with the kind of work and the type of jig used.

The inside dies are made fixed, as shown in Fig. 3, and are preferably made of steel, well insulated. The movable copper clamping dies are placed on the outside and act as electrodes. It is evident that with this arrangement the current will take a path shown by the arrows in Fig. 3. This method subjects the entire welding line to a uniform flow of current,

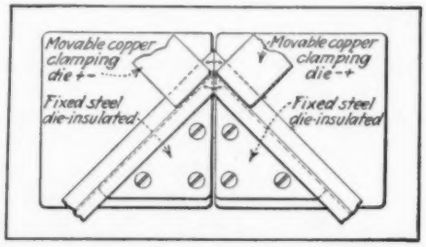



*Fig. 3—A uniform flow of current through the weld results from this construction of the dies*

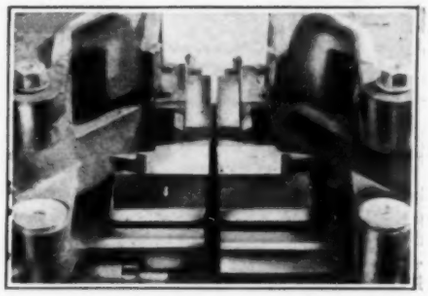
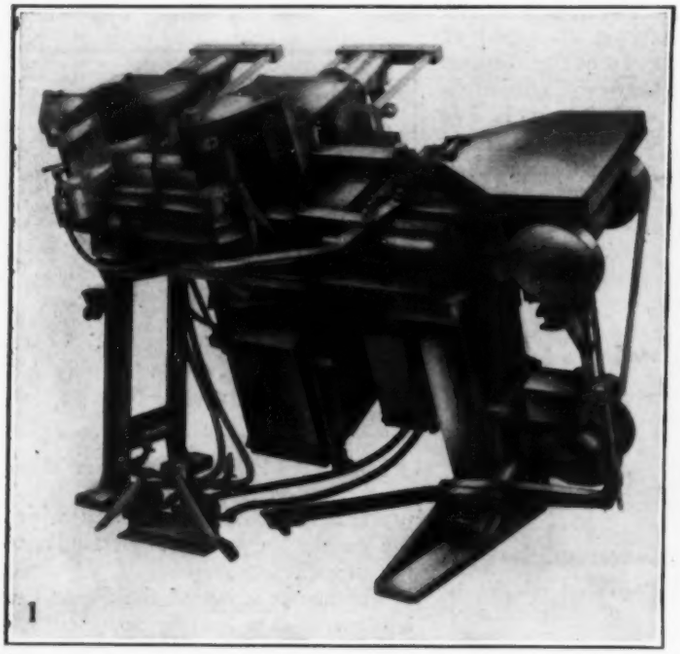


*Fig. 4—View of the stationary and movable dies*

with consequent uniform welding.

As the outside movable electrodes operate in a plane making considerable angle with the inside dies, it is necessary to construct the machine at an angle as shown in the end view, Fig. 2. This is done so that the work may be held in a horizontal plane while welding, as this is particularly desirable when dealing with long sash. A view of the stationary and movable dies is shown in Fig. 4. The movable dies are carried on hinged members and the fulcrum points are well beyond the flashing zone.

The clamping is done by air at 80-lb. pressure per sq.in. acting through large cylinders. The flash and push-up operation is produced by a cam, motor-driven through the medium of a worm-gear reduction unit. The motor is controlled



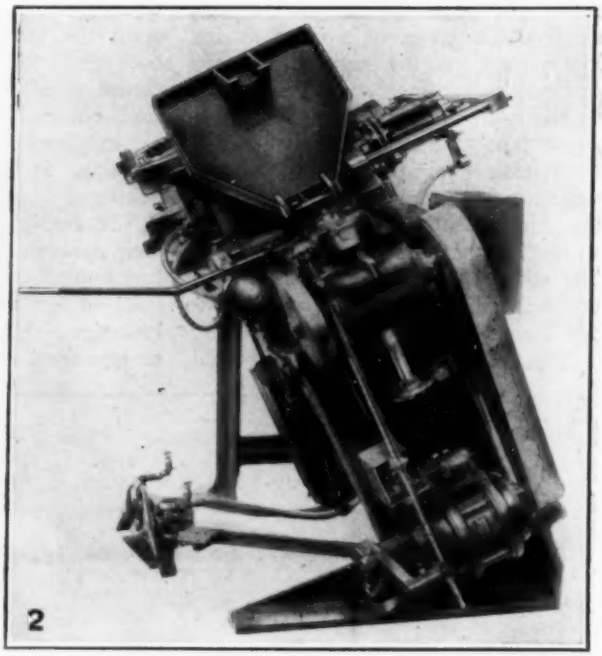




*Fig. 1—Front view of the Federal No. 60 Miter Butt-Welder. Fig. 2—End view showing the butt-welder built at an angle so that work can be held horizontally while clamped in inclined dies*

by an electro-magnetic across-the-line starter. Depressing the lever to the right causes the motor to start, and it continues running until the welding cycle is completed. The advantages of the motor-driven flash and push-up mechanism and the air-operated clamping devices are that they relieve the operator from physical strain and thereby enable him to increase production. The weld made upon this machine has a thin upset which can easily be chiseled or ground away.

## Cincinnati Duplex Brake Drum Grinder

FOR grinding simultaneously the internal and external diameters of hardened-steel brake drums, this duplex brake drum grinder has been introduced, by Cincinnati Grinders Incorporated, Cincinnati, Ohio. It not only has large production capacity but particular attention also has been given to ease of operation, rigidity, and power requirements.

All of the major operations are accomplished by air pressure with a view to eliminating the physical labor involved in obtaining rapid production on a machine of this type. The machine illustrated in Fig. 1 is designed for grinding the drums mounted on the hubs. For grinding the unmounted drums, a differently designed work-holding device is used. The drum assembly is held rigidly against the face plate by a quick-operating air chuck, location being taken from the hub in each instance. Similarly, the entire saddle carrying the work head is driven to and from the grinding position by air under pressure.

The work head is driven by a 3-hp. variable-speed d.c. motor controlled by a conveniently located rheostat. Rotation is started and stopped by push-button control, and the motor is equipped with a dynamic brake to stop it instantly. The power is transmitted through a multiple-strand Texrope drive to a heavy worm and wormwheel keyed to the work head spindle. A speed variation of from 1 to 44 r.p.m. is available for the work holding device.

Provision has been made for mounting the generator on the back of the machine to supply d.c. to the headstock motor in shops where such current is not available. The generator is driven by a silent chain from one of the main drive motors.

When the work is moved up to grinding position, a permanently located stop acts on the air valve to facilitate rapid positioning in relation to the grinding wheels. In addition to this feature to facilitate the setting-up of the machine, a handwheel and gear operating through a rack and pinion are incorporated for hand traversing the work head. A small knob mounted on the traverse plate below the handwheel engages and disengages the traverse gears. When traversing by means of air pressure, the handwheel is disengaged and is unaffected by the movement of the work head.

The V-shaped ways are of ample proportions and are automatically lubricated by rollers dipping into oil wells placed at intervals. When in the grinding position, reciprocation of the work head is automatically obtained by means of a cam mounted on the under side and driven by a chain from the headstock spindle. The reciprocation eliminates wheel marks and reduces wheel wear to a minimum.

The machine is equipped with two independently driven and operated wheelheads, as shown in Fig. 2. The motors are semi-inclosed in the bed of the machine, being mounted in a single bracket directly beneath the grinding-wheel spindles, as shown. In

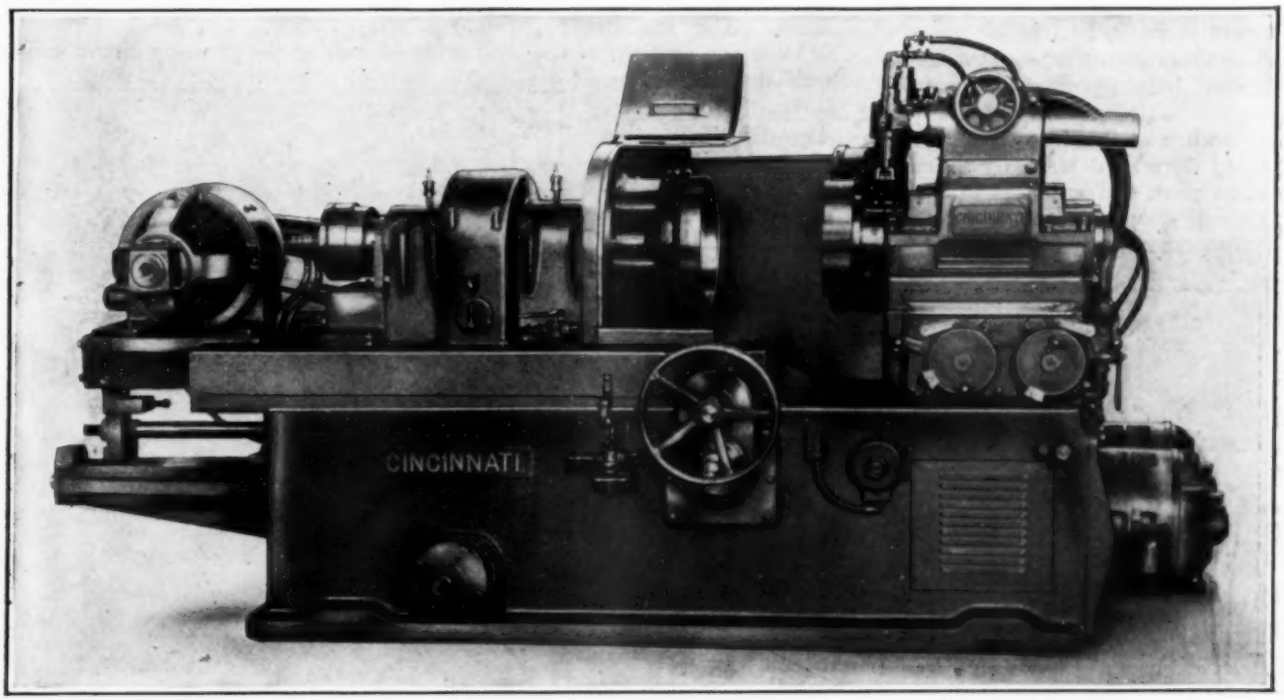



*Fig. 1—Front view of the Cincinnati Duplex Brake Drum Grinder showing the brake drum mounted on the hubs held in a fixture*

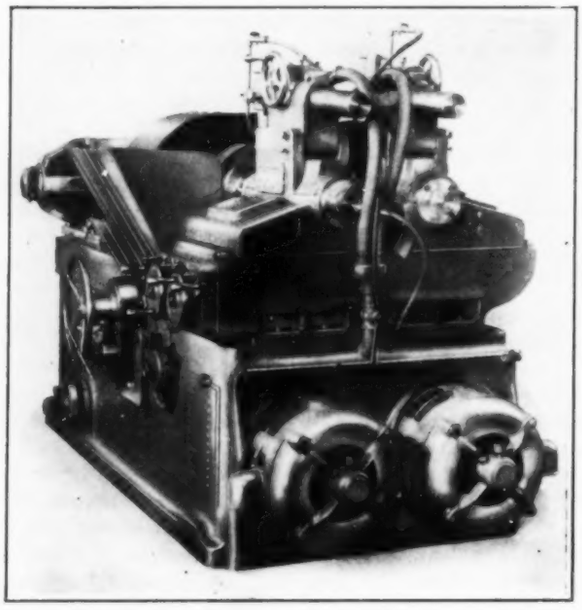


*Fig. 2—End view of the grinder showing the duplex arrangement of the drives and grinding wheel spindles*

order to insure smooth-running spindles, multiple-strand Texrope drives are used. The drives are taken straight from the motors to the spindles with one idler applied to the slack side of the Texropes. The wheel spindles are heavy thus tending to reduce vibration to a minimum. Automatic lubrication is produced by means of centrifugal slingers on the spindles which lift the oil out of the reservoirs in the wheelhead and distribute it into pockets in the spindle caps.

Both wheelheads rest on the long wide dovetailed ways of the wheel-slide plate and are held in place by two full-length adjustable gibs. This arrangement prevents jumping and lifting under heavy cuts or sticking when taking the finishing cuts. The feed movement of the heads is independently controlled and adjusted by two handwheels on the front of the machine which are graduated to read in quarter-thousandths of an inch. The mechanism is arranged with a lever and ratchet so that the heads may be moved into the work with an up-and-down hand motion; the amount of the feed-in being adjustable by set-screws. Positive stops are provided to facilitate duplicate sizing. The front spindle carries a 14-in. wheel for internal grinding and the rear spindle a 20-in. wheel for external grinding, as shown in Fig. 3. Both are counterbored alike and arranged so that when worn down the larger wheel can be transferred to the internal grinding spindle. Hand-operated wheel truing devices are mounted on the wheelheads and rapid-type dressers are used, as shown.

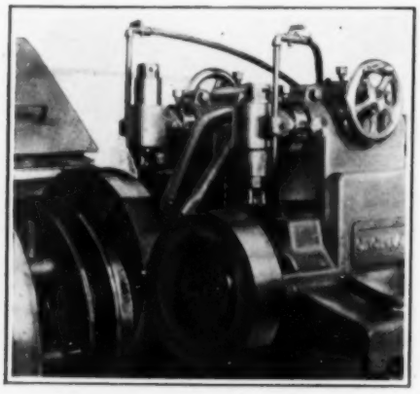


*Fig. 3—Close-up of the grinding wheels showing the adjustable wheel truing devices*

### The Coolant System

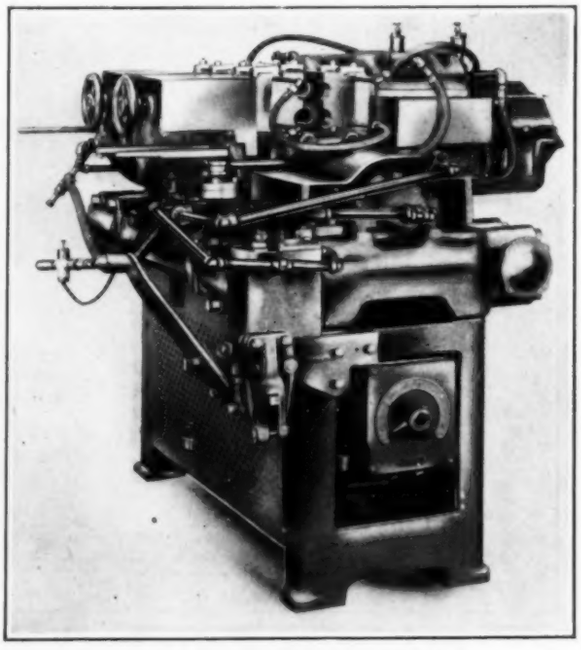
Coolant is supplied from a tank built into the bed of the machine by an independent electrically-driven gusher pump. The pump valve is located so that it is opened by the workhead when in position for grinding, thereby starting the flow of coolant; likewise it is automatically closed when the workhead is withdrawn. Separate coolant supply pipes are taken to the wheel dressers and these are controlled by hand valves. In Fig. 3, these details are shown.

On test, this machine ground from the blank, simultaneously, the interior and exterior diameters of hardened-steel brake drums mounted on the hubs at the rate of 30 drums per hour.

## Thomson Model 55 Flue Welder

THIS Model 55 flue welder has been introduced by the Thomson Electric Welding Company, Lynn, Mass. The machine illustrated is suitable for continuous use, and will weld flues from 2 to 6 in. in diameter. The frame of this welder is of the side-rail type, having the sliding or moving platen bolted directly to the side rails. These rails are round and have their bearings placed at the extreme right and left ends of the frame, thus removing them from the danger of becoming pitted or burned by flash or dirt. In addition, they are amply protected by sheet-metal guards and wipers. The bearings for these side rods have standard bronze bushings which may be replaced quite easily.

The transformer used is of 150-kva. capacity, wound for operation from any standard voltage, 60-cycle, single phase, a.c. line. Operating control of the primary circuit can be



*Thomson Model 55 Flue Welder*

obtained by means of a push-button conveniently mounted and connected to the operating coil of the solenoid-type line switch. The secondary of this transformer is made of cast copper and is water cooled, the water being conducted through seamless steel tubing cast integral. The core of the transformer is of the double-window shell type.

The clamps are air-operated, and are of the horizontal type. Both the clamp bracket and slides are made of cast steel, and there are no sliding surfaces for electrical contacts. The current is carried from the terminal blocks of the transformer to the die blocks of the clamps by means of a patented flexible-lead construction. The sliding surfaces of these clamps are amply protected from flash or dirt by means of suitable guards, and an Alemite oiling system is used throughout. Valves for controlling the air supply to the clamp cylinders are conveniently located at the front of the welder. The die blocks are adjustable both in and out for obtaining accurate alignment of the flues.

The dies are made from cast copper and are watercooled. They are 9-in. long, 3¾-in. thick and 7-in. high. The length of these dies insures sufficient support for maintaining the flues in accurate alignment, and the dies are relieved in their center portion to obtain a higher unit clamping pressure so that slipping may be prevented.

The pressure device is of the hand-operated oil-jack type consisting of a pressure cylinder actuated by a hand-operated oil pump, the complete unit being mounted on the frame of the welder. This unit will produce a total pressure of approximately 9 tons on the ram, and permits accurate control of the flashing, speed, and upsetting pressures.

The current consumption varies with the size of flues welded. On 2-in. diameter flues, the maximum demand is 60 kva. with a power factor of 75 per cent. On 5½-in. diameter flues, the maximum demand is 144 kva., with a power factor varying between 65 and 75 per cent. The height from the floor to the center of the dies is 46½ in. The floor space required is 21 x 53 in., and the net weight is 6,800 pounds.

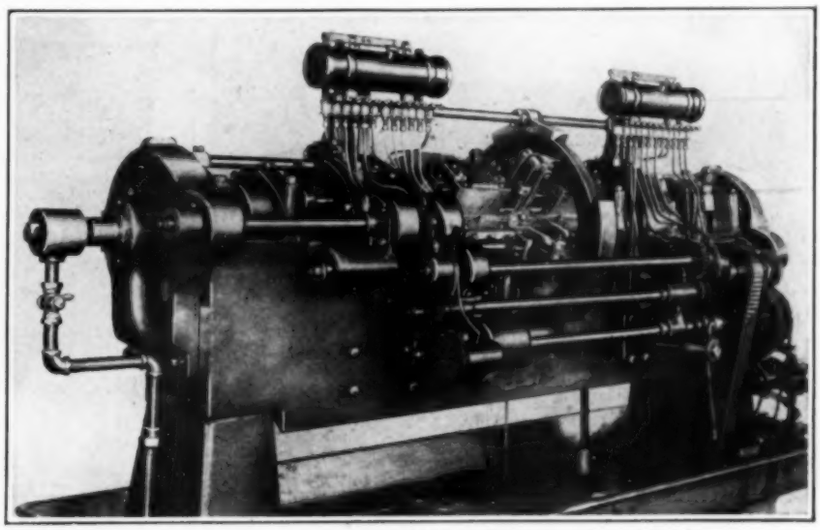
## Davenport Special Automatic Horizontal Drilling Machine

CONTINUOUS operation in the drilling and countersinking of three holes in a door hinge is the principal feature of this specially adapted automatic drilling machine made by the Davenport Machine Tool Company, Inc., Rochester, N. Y. The design of this machine permits the use of five sets of work-holding fixtures and drilling heads which are revolving continuously while the cutting and clamping operations are being performed.

In operating this machine, the operator places the work in the fixture and, as the unit revolves, the work is automatically located and clamped. Three spindles in a cluster box on the left-hand end of the machine drill and countersink the holes simultaneously, after which they are withdrawn and three more spindles on the right-hand end countersink the other side of the hinge. The work-holding fixtures are shown in the illustration. After these operations have been performed, the clamping device is automatically released and the work is dropped into the pan, leaving the fixture ready for inserting a new piece.

Although the center distance of the spindles is somewhat close, they are driven with good-sized, hardened-steel gears. Moreover, the spindles themselves are hardened and run in phosphor-bronze bearings having ball thrust bearings. The drill spindles are fed by a suitable cam located on one end of the machine. Ample cutting compound is forced by a geared pump through the center of the machine to each of the drills by means of conveniently arranged outlets.

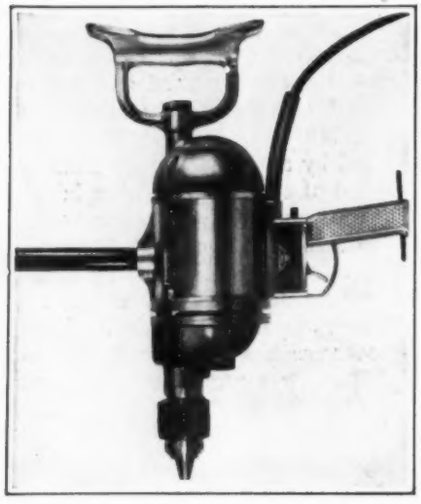
The fixtures make this a single-purpose machine, but the basic principle permits a great variety of work being handled on this type. As there are always four pieces being worked upon simultaneously, the production is rapid, and the operator has ample time in which to load the fixtures. The production is quoted at 1,200 per hour, but it is limited only by the ability of the operator to place the work into the fixture during one-fifth of the time required to revolve the fixture holders.



*Davenport Special Automatic Horizontal Drilling Machine*

## Millers Falls Portable Electric Drills

These portable drills are equipped with universal motors to operate upon d.c. or a.c. up to 60 cycles by merely plugging into any available outlet. They are made by the Millers Falls Company, Millers Falls, Mass. Current of six amperes is required at full load. The spindle runs at 300 r.p.m. when under full load and at 500 r.p.m. at no load. The smaller size has a capacity for holes ⅝ in. in diameter in steel and 1 in. in hard wood. The larger size has a capacity



*Millers Falls Portable Electric Drill*

of $\frac{3}{4}$ and $1\frac{1}{4}$ in. for these two materials, respectively.

The gears are of heat-treated alloy steel. The spindle runs in bronze-bushed bearings and is equipped with a ball thrust bearing. The motor shaft in each case runs on ball bearings. The aluminum housing is correctly ventilated to insure cool running. The spade handle and breast plate are adjustable.

Current reaches the motor through a double-pole, double-break switch manipulated by a well-guarded trigger, and provided with a catch for continuous operation. Jacobs drill chucks are furnished with each tool, and there is a spring clip to hold the wrench, or key, so that it cannot get lost. Fifteen feet of rubber-covered cord is furnished with each outfit.

The running parts are grease lubricated and need no attention. The overall lengths are $19\frac{1}{4}$ in. for the No. 658 and $19\frac{3}{4}$ in. for the No. 634. Weights are 20 and $20\frac{1}{4}$ lb., respectively. Motors can be furnished to operate at 110, 150, 200 and 250 volts, according to requirements.

## Morton Car-Journal Bearing Finishing Miller

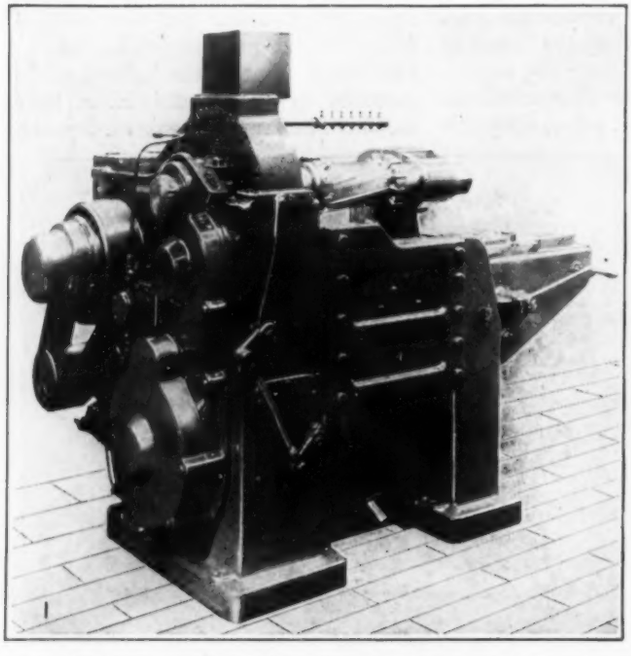
THIS finishing miller is especially designed for finishing in one operation the surfaces, fillets, and ends of A.R.A. standard car-journal bearings after being babbitted. The machine has been introduced by the Morton Manufacturing Company, Muskegon Heights, Mich. The column of this machine is of box construction, and is designed with fixed center distance for shaft and gear journal bearings, insuring alignment at all times.

The chuck for holding the brasses is of square box construction, and is provided with rotating jaws which open and close automatically as the chuck is raised or lowered to and from the cutter. It is fitted to a running bearing between the columns and side plates. The chuck is raised and lowered by a quill which is threaded on its lower end. The quill is provided with lock nuts for raising and lowering the connecting members for the purpose of adjustment when setting for bearings of different sizes. Steel jaws, which can be quickly placed in position and removed, are furnished for the various sizes.

The adjusting lock nuts on the quill are provided with eight slots for a spanner wrench. Power for raising and lowering the chuck to and from the cutter is applied through levers and adjustable connections through a shaft. An especially designed cam raises the work to the cutter.

The cam is so designed that the work moves quickly up until it comes in contact with the cutter. It then feeds the work against the cutter in the ordinary way. After finishing its operation, the chuck quickly lowers and automatically releases the jaws, leaving the work free to be removed. Power is transmitted to the cam through gears from the arbor.

The eccentric adjustment applied to the trunnion for raising and lowering the chuck provides a means



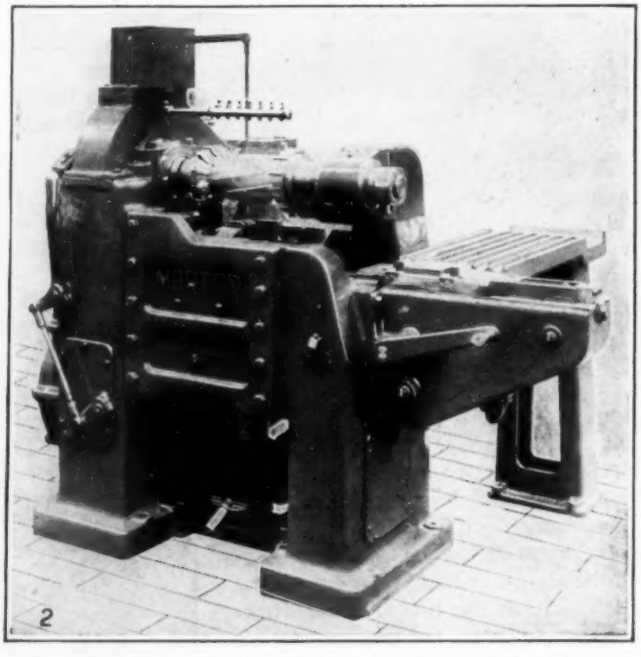




*Fig. 1—Front view of the Morton Car-Journal Bearing Finishing Miller. Fig. 2—Rear view of the milling machine*

whereby the work may be raised to have a second cut taken when required. The controlling quadrant has three notches, each giving 26/1000-in. adjustment. When the bearing does not clean out perfectly on the first cut because of shrinkage, the lever may be shifted one notch as the chuck returns to its down position and the second cut made without removing the work. This operation may be repeated for a third and fourth cut when necessary.

### Easy Control

The controlling lever is located within easy reach of the operator as shown in Fig. 1. Power is applied through gears for driving the cutter and arbor. A friction clutch and brake are used for stopping and starting. The machine stops automatically when the chuck is at its lowest position.

The main driving arbor is hollow and journalled with adjustable bronze bearings. The cutter arbor is fitted and feather keyed, permitting adjustment sideways for aligning with the work. The arbor and the shafts are made from special spindle steel. The bearings are bronze-bushed and those in the main column are automatically oiled. The gears are cut from the solid and made from special gear iron. All pinions subject to heavy strain are made of steel. They are inclosed and run in oil.

The outer bearing for the cutter arbor is tongued and fitted to a centering slot held in position by two bolts. It may be quickly removed by unscrewing the round compression nuts and sleeve bearing. This makes possible free and easy removal of the cutter.

The cutters are made with adjustable special steel blades which may be set out as required after several regrindings. The filleting cutters are secured to the body of the journal sizing cutter and may be adjusted to meet requirements.

The lubrication of the cutter is done automatically by gravity. A supply tank is located on the top of the gear case. A valve is operated by levers and a vertical rod lifted by the chuck as the work strikes the cutter. The valve is closed as the chuck lowers. This gives the correct amount of oil to insure perfect cutting. A manifold with needle valves to regulate the drop and distribution for different size cutters is provided.

The automatic oiling system for all bearings in the main column consists of a supply tank in the compartment in which the cam operates. The oil is carried at a suitable level so that the cam is covered with oil at each revolution. A rotary pump draws oil from the tank and discharges it into a receptacle in the main gear housing. From there it is delivered through tubes to the several journal bearings and to the face of the main driving gear, returning thence to the supply tank.

The bearing loading carriage attached to the right-hand column, Fig. 2 enables the operator to place the work in the chuck without injury from the cutter. The column has an opening through the side for loading and unloading the work, which insures ease and safety in this operation. The bearing is placed on a sliding plate. By moving the lever to the left, it is set in the operating position and is centered with the cutter. After it has passed through the cutting cycle, the lever is moved to the right and the bearing is positioned for unloading.

The power for driving the machine may be supplied by a direct-connected, constant-speed motor, of either the a.c. or d.c. type. The motor is secured to a bracket provided with adjustments for applying tension to the endless belt. When electrically-operated, the push-button control for stopping and starting is placed within easy reach of the operator. The machine may be driven, however, from an ordinary countershaft.

## Westinghouse Portable Instruments

Several types of portable instruments for both a.c. and d.c. measurements have been put out by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. The d.c. instruments are known as type PX2, and are of compact design and intended for accurate work. They are particularly suitable for automobile, battery, radio, and miscellaneous testing. The a.c. instruments are designated as PY5, and are of the direct-reading type, suitable for general testing and laboratory work, where high accuracy is required.

The d.c. instruments are of the

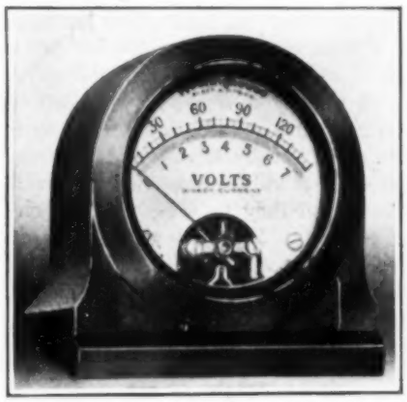



*Fig. 1—Westinghouse Type PX-2 Portable Double-Range Voltmeter for d.c. circuits*

permanent-magnet moving-coil type and operate on the D'Arsonval principle. The moving coil rests on hardened-steel pivots moving in sapphire jewel bearings. The mechanism is mounted on a molded micarta base and has a case of the same material. A mirrored dial and a knife edge pointer facilitate accurate reading. This line of instruments includes millivoltmeters, double-range voltmeters, milliammeters, ammeters, radio-frequency ammeters, and galvonometers.

The voltmeters and single-phase wattmeters of the a.c. group are of the electrodynometer type. The ammeters are of the moving-iron type using vanes of non-residual metal. All instruments are shielded and are damped by an improved design of air

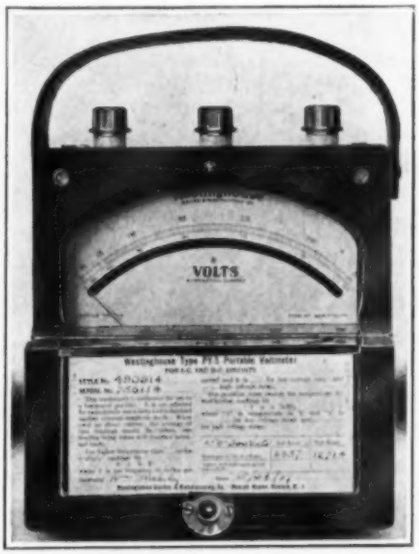



*Fig. 2—Westinghouse Type PY-5 Portable Voltmeter for a.c. circuits*

damper making possible accurate measurements on fluctuating loads.

The ammeters have a double range which can be changed while the meter is in use by a series-parallel switch mounted in the case. The movements are mechanically strong and will successfully stand high momentary overloads, and they may be used on circuits up to 500 cycles and also on d.c. with but a slight reduction in accuracy.

The voltmeters have an accuracy to within ¼ per cent and can be used without appreciable error on d.c. and a.c. up to 133 cycles. They are provided with a push-button for closing the circuit. This can be locked in the closed position when using the instrument for continuous service.

The single-phase wattmeters have an accuracy to within ¼ per cent and may be used on circuits up to 400 cycles without requiring correction for phase displacement. The current circuits are double range with series-parallel arrangement of coils, and are controlled by a switch inside the instrument operated by a knob in a recess in the case. The voltage ranges are changed by changing the terminal connections. The voltage circuit contains a push-button switch which may be locked in the closed position when continuous operation is desired.

## Sykes No. 4-A Improved Gear Generator

AN IMPROVED Sykes gear generator in a size known as the No. 4A has been placed on the market by the Farrel-Birmingham Company, Buffalo, N. Y., holders of the American patent rights. This machine, illustrated in Fig. 1, has many improvements in design over the previous machines. These improvements enable continuous-toothed herringbone, single-helical, and straight-toothed gears to be cut in less time than previously taken, and it is claimed that the finish on the teeth of the gear is improved, and a greater accuracy of tooth contour and division is obtained.

The general principle of operation of these machines was described on page 554, Vol. 63, and a brief description of new features of design of the size No. 2A was given in Vol. 66, p. 273, of the *American Machinist*. A diagram of the generating mechanism is shown in Fig. 2. It will be seen that the principle adopted is that of the generating molding process, which is the basic principle of all gear-generating machines. Simplicity of operation is claimed for these machines. Since there is only one set of change wheels used and since they have a ratio equal to the ratio of the number of teeth in the cutter to the number of teeth in the wheel to be cut, complicated calculations are avoided. These wheels regulate the speed of rotation of the cutters and of the gear blank so that they revolve at the same relative speeds they would have if the cutter were a pinion and the blank already had the teeth cut upon it.

The rotation of cutter and blank is continuously in one direction and there is no intermittent indexing. Therefore, the cutters and blank may be revolved until all errors are removed from the teeth. Simultaneously with the slow rotary movement of the cutters, the reciprocating carriage, on which they are supported, is reciprocated longitudinally, thus imparting the cutting action to the cutters. The cutters are attached to guides, which may be either straight or helical, depending upon the type of gear to be cut. When helical

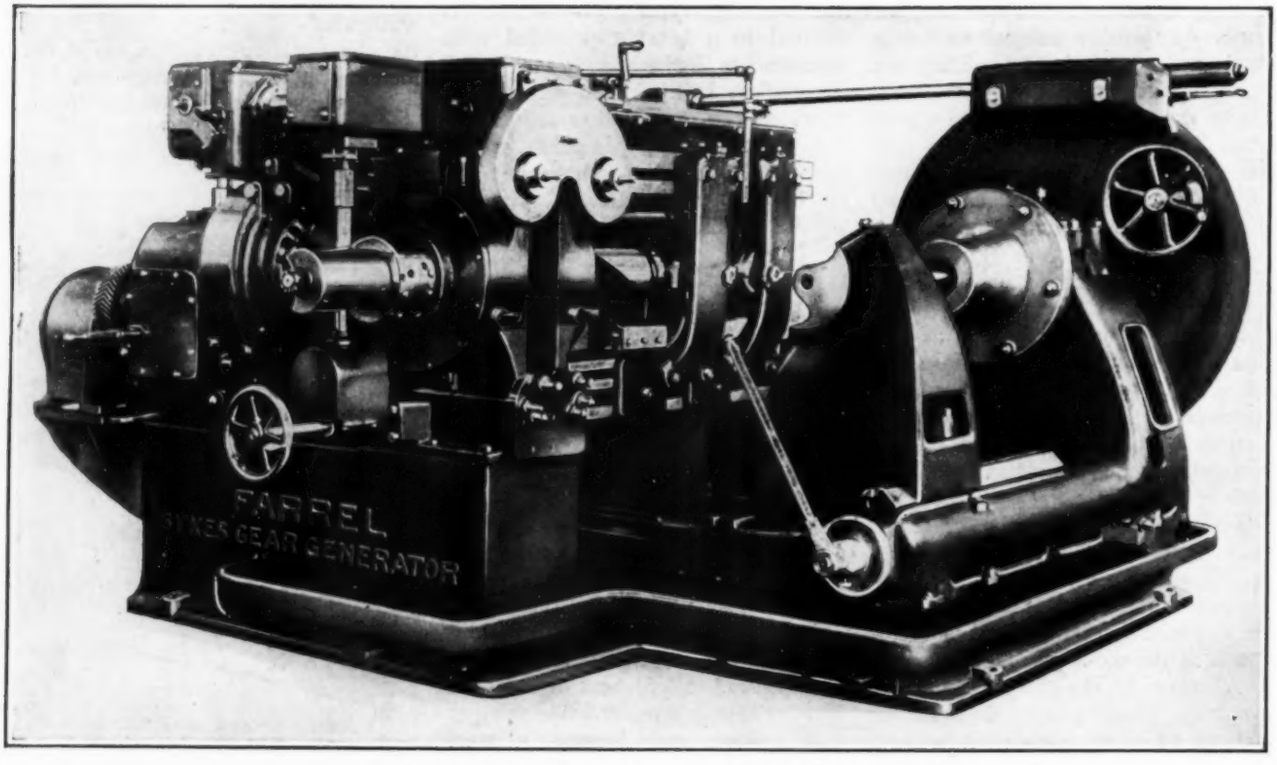



*Fig. 1—Sykes No. 4A Improved Gear Generator*

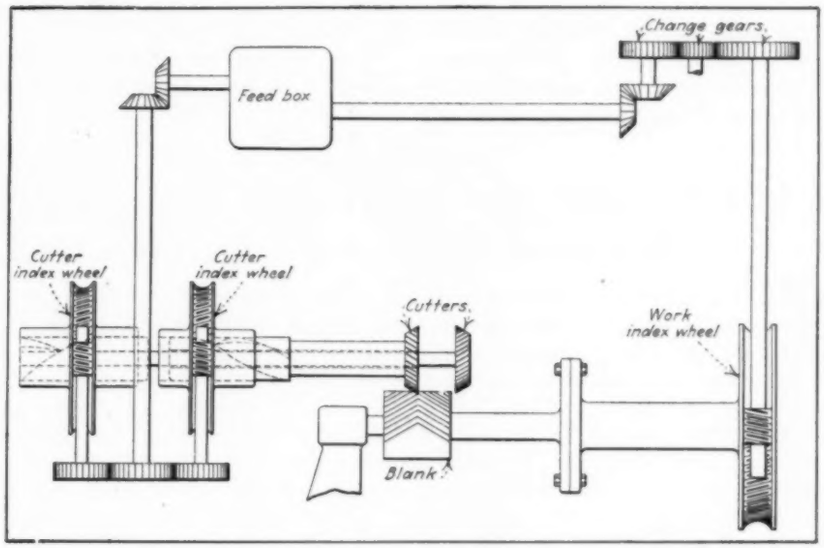



*Fig. 2—Diagrammatic scheme of the generating mechanism*

guides are used they give to the cutter a helical twist which generates the helixes of the teeth of single- or double-helical gears.

The machine makes possible the generation of a continuous-toothed herringbone gear with no tool clearance in the center of the face width. Double helical gears have heretofore not been used extensively in the smaller sizes since the tool clearance for the hobbing process detracted from the strength of the gear and decreased the bearing surface sometimes as much as 40 per cent. These objections to small double-helical gears are thus removed and their increasing use is expected.

The No. 4A machine now being marketed will cut double-helical gears of either continuous- or staggered-tooth design from 1 to 49 in. in diameter, from 1 to 18 in. width of face, and from 10 to 1½ D.P. It will generate straight-tooth or single-helical gears up to 10 in. in width of face between the limits of diameter and pitch given above. It will also cut cluster gears simultaneously, which is claimed to be a distinct advance in the art of gear cutting.

The operation of cutting cluster gears having two gears of different numbers of teeth, simultaneously, is effected by having two cutters with different numbers of teeth, the difference in number of teeth being equal to the difference between the teeth of the two gears in the cluster. They are rotated at different speeds by using a compound gear train in the cutter dividing mechanism.

The bed of the machine is similar to that of the previous model, but the work-saddle ways are extended forward so that at all times they are beyond the point where the cutters are operating on the blank. This causes any deflection of the blank to be away from the cutters. The back of the work saddle has been raised and the bracket supporting the work mandrel is now seated on V-ways which are raised and are radial to the gear cutter. This gives more rigid support to the mandrel, permits heavier cuts to be taken, and reduces deflection to a negligible amount. The bracket supporting the outer end of the mandrel is bored to a semicircular form, so that pinions with large extended shafts up to 9-in. in diameter can be fitted in bushings and held rigidly.

The blank is fed into the cutters by a fine-thread nut and screw which is operated by a large ratchet lever from the side of the work saddle. This lever is placed in such a position that it is easy to operate as the operator can see the cutters operating upon the blank. For setting up the blank a quick power traverse is provied for the work saddle. For truing the blank the worm driving the dividing wheel is lifted out of mesh, the work spindle being rapidly rotated by a handwheel. The cutter brackets are heavier than on the smaller machine and two locking screws instead of one are used. The tension of these screws is equalized by using two worms of opposite hand floating axially.

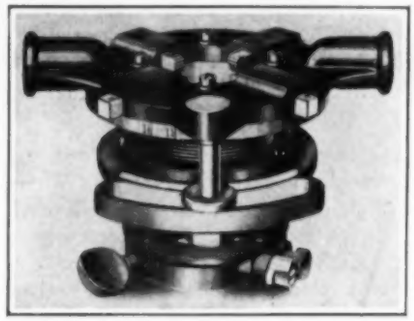
An important feature of the improved model is an adjustable pair of rim supports for the wheel blank. These are operate quickly from a handwheel on the side of the machine, and the same system of equalizing screws as used for the cutter heads is employed to insure that each support is in its proper position on the rim of the wheel. The point of contact of each support is just above the cutting point. Half-nuts are used for the screw adjustment so that when small gears are being cut the supports may be easily removed.

It is claimed that the machine will generate straight-tooth and helical-tooth gears with great savings of time. For example, a 75-tooth cast-steel gear having 2½ D.P. and a face width of 8 in., can be generated in from 4½ to 5 hr. actual cutting time. The machine is direct-driven, through Sykes herringbone gears, from a 10-hp. motor.

## "Beaver" Nos. 11 and 11A Die Stocks

These "Beaver" adjustable die stocks, No. 11 plain and No. 11A ratchet, are being manufactured by the Borden Company, Warren, Ohio. Both Beaver stocks have one set of dies that can be quickly set to thread 1-, 1¼-, 1½- or 2-inch pipe. The dies cannot become lost or mislaid because they are always in the tool ready to be used. They can be adjusted to thread under or over standard size without affecting the length of the thread. Either the No. 11 or No. 11A stock cuts correct threads on any kind of pipe, including brass. The threading dies in these tools are made of high-grade alloy steel, hardened and tempered.

The work holder or gripping device accurately centers the pipe. Two knurled screws hold firmly to the

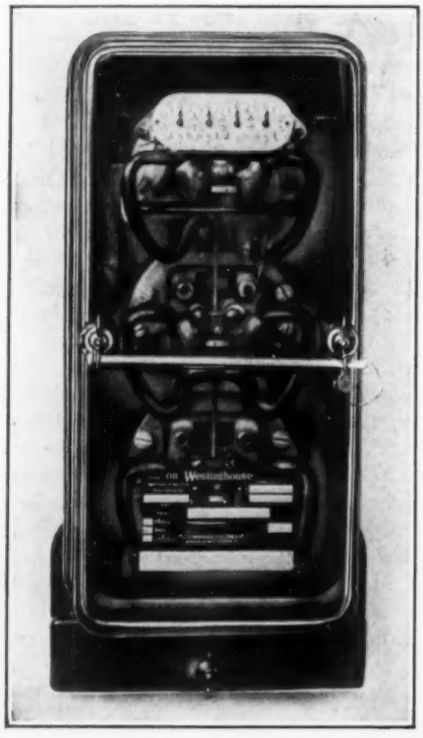


*"Beaver" Die Stock*

pipe size when set, leaving only the thumb screw to be tightened after the die stock is placed on the pipe. Loose bushings are eliminated. When the collar is set to size, only a straight thread can be cut, but it may be quickly and easily adjusted to cut crooked or drip threads if desired. It will also grip any size coupling for threading short nipples. In these stocks the die head and threaded barrel are two separate parts.

## Westinghouse Type OB Three-Element Watt-Hour Meter

Correct energy measurement may be made regardless of current unbalance, voltage unbalance, or power-factor by means of the type OB three-element watt-hour meter which has been introduced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The meter



*Westinghouse Type OB Three-Element Watt-Hour Meter*

is designed primarily for use on three-phase, four-wire circuits where a high degree of accuracy is desired.

In construction, the meter consists essentially of three single-phase elements placed one above the other, having all three disks mounted on a common shaft. The torques of all three elements are totalized and the energy measured on one register. The elements each have adjustable power-factor loops, and are fully compensated for variations in temperature.

The entire meter element is a unit assembly, and can be removed from the case.

## Olsen-Lundgren Improved Centrifugal Dynamic Balancing Machine

SEVERAL additional features have been incorporated in the improved model of the Olsen-Lundgren centrifugal dynamic balancing machine, illustrated in Fig. 1, and now being placed on the market by the Tinius Olsen Testing Machine Company, Philadelphia, Pa. The supports for the rotor to be balanced, shown in detail in Fig. 2, are of the ball-bearing roller type, and are provided with ball-bearing support so that each bearing may oscillate freely to obtain correct alignment in supporting the rotor. A new type of coupling has also been developed, incorporating a ball-bearing universal joint instead of the former driving pins. This arrangement has the advantage that any ordinary misalignment between the spindle and the piece tested does not interfere with the accuracy of the reading. The rotor being tested can be quickly disengaged from the adaptor, and the time required to mount the part to be balanced is also reduced to a few seconds. The supports for the rollers can be readily adjusted to various lengths. Each one is provided with a quick-locking mechanism to facilitate taking the reading of unbalance at either bearing, so that the one support will be entirely free from the other in taking the readings.

To transfer the amount of unbalance and angle as shown by the machine so that corrections may be made at any two points along the length of the rotor, an entirely new transfer instrument shown in Fig. 3 has been developed. By quick and simple adjustments it makes possible the correct reading of the amount of unbalance in ounce-inches, and the angular plane of unbalance required at selected points of correction from readings taken at the bearing support. It does away with the necessity of making computations and preparing large numbers of charts.

The transfer instrument consists of a supporting frame with two side

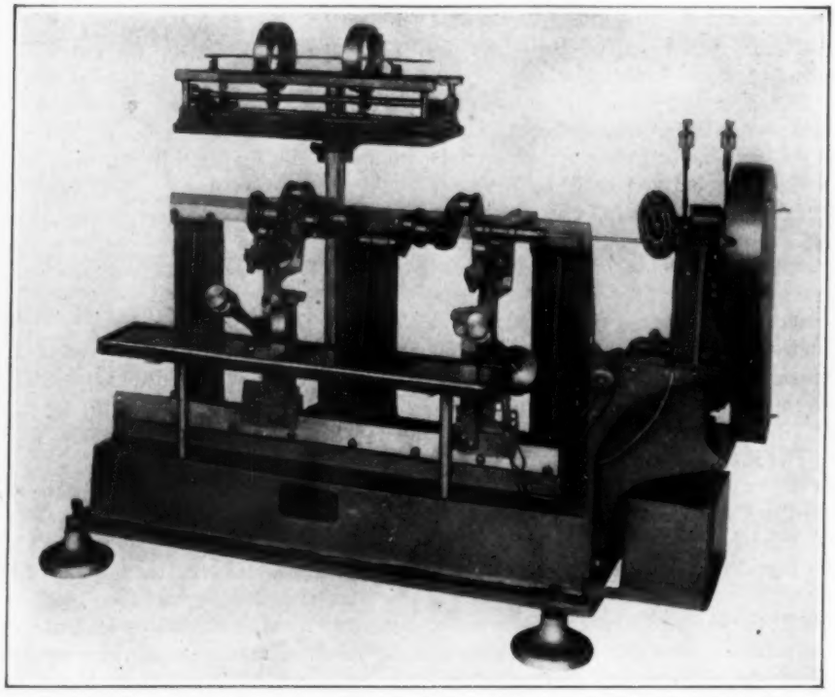


*Fig. 1—Olsen-Lundgren Improved Centrifugal Dynamic Balancing Machine*

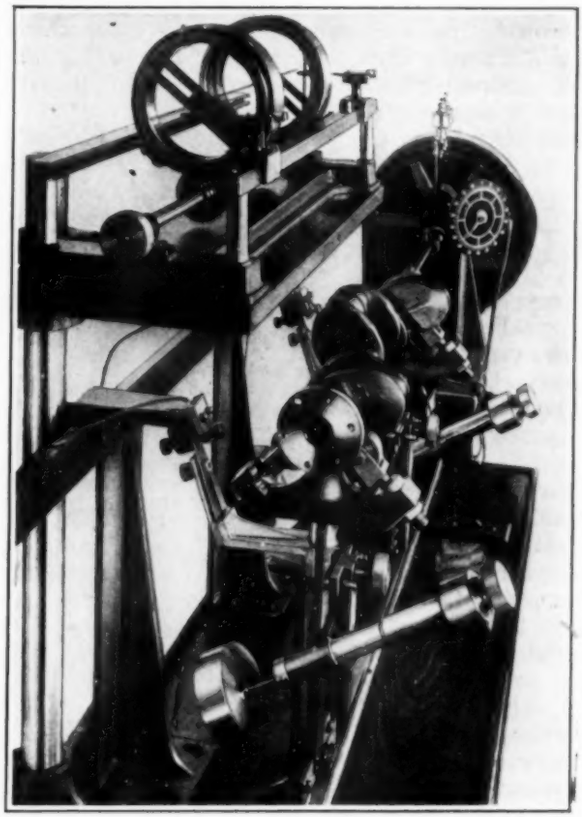


*Fig. 2—End view showing crankshaft to be balanced in position on the rollers*

rods, one of which is graduated to indicate the distance between bearings or supports. On these side rods two dials operate. These dials are set to the distance between which it is desired to make corrections on a rotor. To operate this instrument the two indicators on the horizontal scale are first set to the distance between supports. The circular disks are then set to the distance between points of correction, and each revolved to indicate the angle of unbalance at the bearing as indicated by the machine, while on each ring an indicator is set on the cross scale to indicate the amount of unbalance at each bearing as shown by the machine. The rings are then operated by the small knurled head at the right and revolved until the central rod comes into contact with the slide scale operating on the two supports on the horizontal scale. When this rod and indicator come together at the extreme front position the operator takes the reading of unbalance directly from this scale and the angle from the circular indicator. These give the new amount of unbalance and angle reading to be corrected at the two points along the length of the rotor at which it is desired to make the correction. The new angles of unbalance are then marked directly on the rotor before removal, and the amount of unbalance as indicated by the instrument is removed. Where balancing work is of a uniform character such as in production balancing of similar parts, the same setting of the instrument is used continuously, and only when the length of rotors or the distance between the point of correction vary are resettings required. For balancing crankshafts or other parts, the rotor to be tested is mounted on the roller and connected to the driving coupling at the right. When the machine is started in motion any unbalance that is in the rotor throws the front roller forward, making electrical contact and causing sparks between the pointer and the dial when the former is in the angle of unbalance. This angle is therefore easily readable on the dial. When the two switches are on, the unbalance angle at either end of the rotor is noted by the sparking, and it can be seen that if the two angles coincide only a static unbalance is present in the rotor, whereas if they come at exactly opposite angles a dynamic unbalance is present. If the sparking comes at varying angles, a combined static and dynamic unbalance is present.

To indicate the amount of unbalance at each bearing a new form of micrometer compensating device is used, and by turning a small wheel at either bearing a force is introduced to counteract the centrifugal force of the unbalance. This micrometer screw is shown in Fig. 2. When the centrifugal force has been counteracted at either bearing so that the sparking ceases, the amount of unbalance in ounce-inches is read directly on the barrel of the micrometer surrounding the weight-applying mechanism.

For the production balancing of crankshafts the shaft is merely placed on the roller supports and coupled in place, the machine then being set in operation. The operator next snaps the two switches thus securing instantly the angle of unbalance at each bearing, and by adjustment of the micrometer screws he obtains the amount of unbalance in ounce-inches at either bearing. The readings of angle on the dial and the ounce-inches on the micrometer screws are taken directly in fixed positions only, usually the bearing points in the case of shafts. This is usually sufficient in production work for one class of work, but if it is required to transfer the readings to any other position of the work the transfer instrument is employed as described and no calcu-

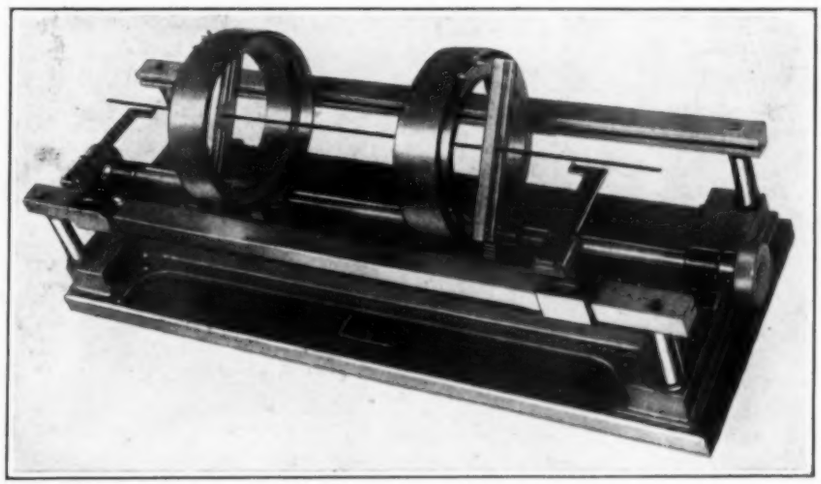


*Fig. 3—Transfer instrument for Olsen-Lundgren balancing machine*

lations are required for final results.

The improved dynamic balancing machine is available in any desired size suitable for balancing very small rotors of ½ lb. in weight up to the largest size turbine rotors. It is made to suit different lengths and classes of work and any specified graduation other than ounce-inches can also be furnished on the dial and instrument. The wiring of the machine is entirely self-contained, and is piped so that no additional outside wiring is required.

## Stevens No. 2 "Duple" Horizontal Drill

TO MEET the demand for a larger machine than the No. 00 for such operations as boring, bevelling, chamfering, reaming, facing, and some classes of threading and tapping, this No. 2 "Duple" horizontal drilling machine has been developed by John B. Stevens, Inc., 27 Cleveland Place, New York City. This design provides greater power and ease of operating than found in the smaller model. The No. 00 drilling machine was described on page 514, Vol. 67, of the *American Machinist*. The front of the machine is of deep, massive construction, having four wide crossbraces as well as closed ends. Vs $2\frac{5}{16}$ in. wide at their bases assure maintenance of the spindle alignment. A fixture table is placed at the center, with a ¾-in. slot running through the center and parallel to the Vs of the bed. The dimensions of the fixture plate are 12x16 inches.

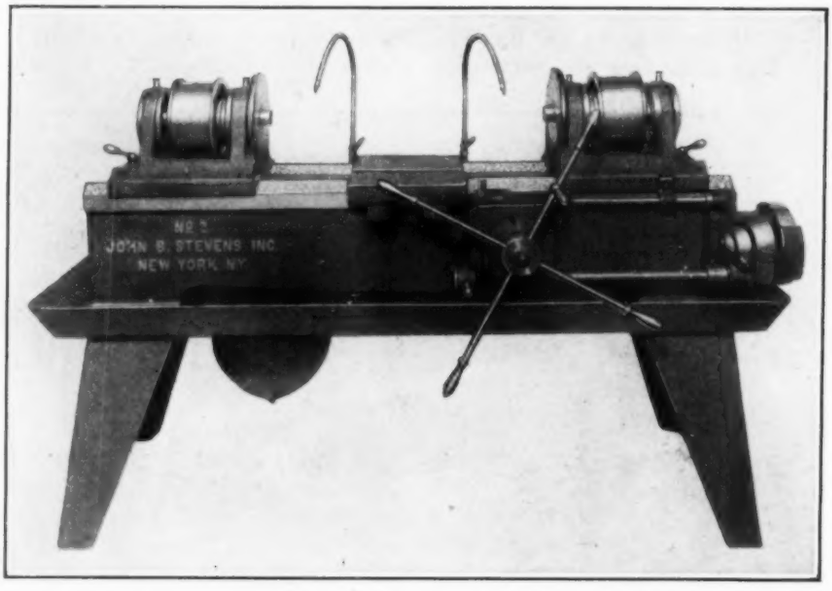
The heads are of massive construction and are gibbed down to the bed Vs, with adjustable taper gibs interposed to take up wear. The ratio of the length of the head fitted on Vs with the spindle height over Vs, is more than 2 to 1. The spindles revolve in large ball bearings carrying both radial and thrust loads. Cross-slots in the spindles engage the tangs of drills which may be ejected by a knock-out rod.

Each head is fed forward by a 1½-in. diam. square-threaded screw revolving in large ball bearings, and having end-thrust taken by ball bearings. A cross-shaft, equipped in the same manner with ball bearings, carries a helical bevel gear meshing with two other such gears on each of the head driving screws. The front end of the cross-shaft carries a large bronze worm gear driven by a hardened-steel worm on the worm shaft, which extends to the right as shown in the illustration, and which is driven through gears by means of a belt drive from the right-hand countershaft. This worm shaft, like the other feeding parts, revolves in ball bearings, and has its thrust taken up by thrust ball bearings. Four change gears are furnished which permit three different feed changes. A safety shear pin is provided to prevent overloads causing damage to the machine. Hand and automatic trips for the feed are provided, and also a positive stop.

Countershafts are supplied for each head complete with tight and loose pulleys. These countershafts are designed especially to transmit the power for which the machines are built.

SPECIFICATIONS

| | Plain Head | Back-Geared Head |
|---|---|---|
| Maximum drilling capacity, cast iron, in. | 1¼ | 1¼ |
| Maximum drilling capacity, steel, in. | ¾ | 1¼ |
| Swing over Vs, in. | 14 | 14 |
| Maximum distance between spindles, in. | 36 | 36 |
| Minimum distance between spindles, in. | 10½ | 10½ |
| Morse taper for spindles, No. | 4 | 4 |
| Feeds per revolution of spindle, in. | 0.0003<br>0.0065<br>0.014 | 0.0045<br>0.0105<br>0.014 |
| Length of head fitted to Vs, in. | 14 | 15 |
| Floor space, in. | 80x24 | 80x24 |
| Weight, lb. | 2,450 | 2,600 |



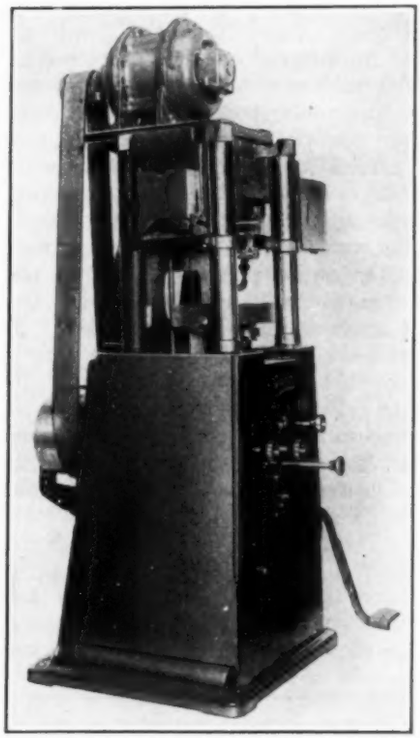

*Stevens No. 2 "Duple" Horizontal Drilling Machine*

## Martin No. 14 Hydraulic Marking Machine

This No. 14 hydraulic marking machine has been brought out by the Martin Machine Company, Turners Falls, Mass., to mark, knurl, or score articles requiring heavy pressures. The machine is of the roll type, in which the marking tool is a roller and the work to be marked is passed horizontally beneath it as pressure is applied by means of the hydraulic mechanism, thereby avoiding the destructive effect of a blow upon the marking tool. It is self-contained; power to operate it is supplied by an electric motor mounted above the machine.

The base forms a reservoir to contain the oil, which is delivered under pressure to the hydraulic cylinders by a constantly-running rotary pump. The work is held in suitable fixtures upon a table that traverses from right to left. When the treadle is depressed, the table rises to bring the work into contact with the marking roll and moves slowly to the left to pass the roll over the surface to be marked.

The cycle may be arranged to stop when the marking is complete, or by securing the treadle in the depressed position by means of a latch, the cycle becomes continuous and the operator is required only to load and



*Martin No. 14 Hydraulic Marking Machine*

unload the work pieces. The speed of the cycle is easily adjustable to suit the convenience of the operator and the nature of the work. No severe manual effort is required to operate the machine, hence it can be run by women. No skill is required other than to set the work pieces into the fixtures properly. On pieces requiring especially heavy impressions, the table can be caused to pass back and forth an indefinite number of times without danger of blurring the lines. The machine weighs 2,000 lb., and occupies a space approximately 36 in. square on the floor.

## "Optimus" Type REI Plating-Tank Rheostat

Definite control of plating baths is assured by the use of this "Optimus" Type REI plating-tank rheostat which has been developed by the Hanson-Van Winkle-Munning Company, Matawan, N. J. The apparatus is suitable for use with all plating solutions whether of chromium, nickel, brass, copper, cadmium, zinc, tin, gold or silver.

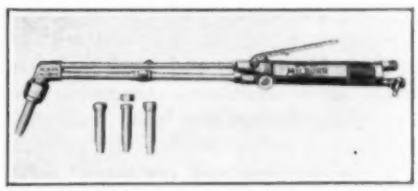
The design and construction of this rheostat is in accord with power apparatus standards. It is mounted upon an asbestos panel board. Resistance coils, Fig. 2, are mounted on studs back of the panel board in a manner permitting good ventilation and eliminating loosening of coils. Standard knife switches, Fig. 1, are used instead of those of the battery type and provision is made for a maximum number of resistance variations with a minimum number of switches and settings.

The Type REI rheostat is equipped with a voltmeter and ammeter mounted on the rheostat panel. The instruments and shunt are arranged so as to prevent distortion of the meter readings. The voltmeter permits the plater to read not only the line voltage, but also the voltage drop from the anode to cathode directly at the tank. This latter reading is of importance in determining the conductivity of the solution. The ammeter shows the total current passing through the solution, so that with a known cathode surface exposed, the current density can be readily calculated. With this calculation established the amount of deposit in a given unit of time is easily and definitely determined.

By means of the Optimus rheostat, the total resistance of a plating tank can be adjusted so as to regulate the current density in the plating bath by means of knife switches controlling the various resistances. Therefore, a constant voltage drop from anode to cathode can be maintained regardless of changes in the area of the cathode surface in the tank. As the voltage at the tank regulates the current density of plating, the average thickness of deposit in a given time is also definitely controlled, thus insuring uniform results.

## Milburn Combination Cutting and Welding Torch

A convertible tip permits the Type TI cutting and welding torch manufactured by the Alexander Milburn Company, 1416-1428 West Baltimore St., Baltimore, Md., to be suitable for both cutting and welding operations.



*Milburn Type TI Combination Cutting and Welding Torch*

When the tip is in one position, the gas is automatically passed to the preheating gas passages while the high pressure oxygen is carried through the central hole for cutting. By a quarter turn of the tip, the oxygen is cut off and the welding gases are conveyed through the central passage of the cutting tip, thus a welding flame results.

Torch heads, valves, bases and other parts made from bronze forgings are responsible for lightness and durability. The seamless high-pres-

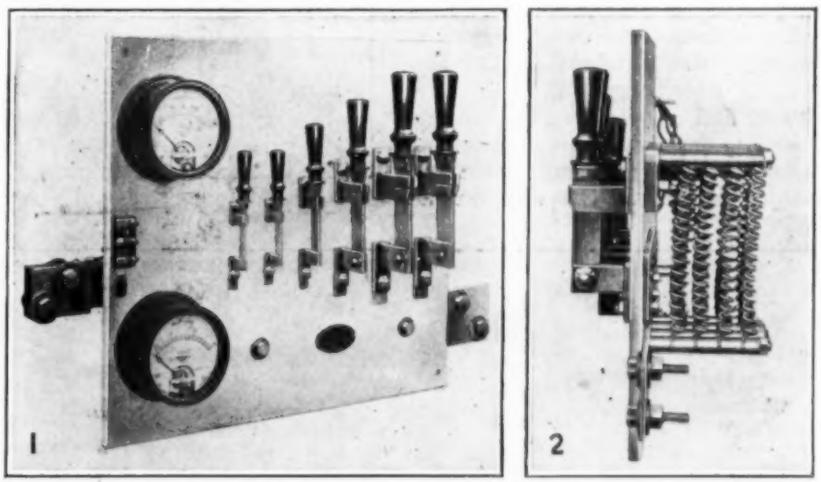



*Fig. 1—Front view of the "Optimus" Type REI Plating-Tank Rheostat showing the meters and the knife switches controlling the resistances. Fig. 2—End view of the rheostat showing method of mounting the resistances*

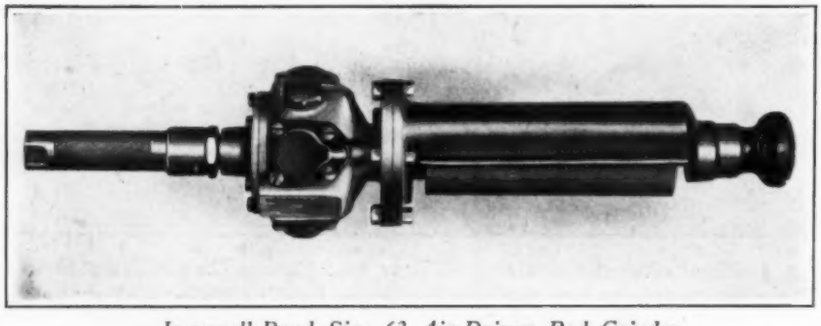
sure tube is especially drawn with triple-thick walls, and is made of nickel silver. The tips have been constructed so that when they have outlived their usefulness for cutting operations, they will still be serviceable for welding.

## Ingersoll-Rand Size 63 Air-Driven Rod Grinder

Several types of railroad work are included in the scope of this Size 63 air-driven rod grinder which has been developed by the Ingersoll-Rand Company, 11 Broadway, New York City. This tool, which takes a 6-in. grinding wheel, is provided with an outboard bearing and hand grip, and has been developed primarily for grinding locomotive side and main rods, and valve motion rods previous to the buffing and polishing operations. Its compact and light construction and its wide-faced wheel, make it suitable for grinding many wide surfaces that are to have a smooth finish. Other applications in the railroad shop include the grinding of welds on side rods, grinding brasses to fit main rods, grinding the jaws in the main rods to smooth them for new brasses and grinding reliefs on brasses.

The pneumatic motor of this grinder has three cylinders spaced about the center line of the spindle. All deliver power to one crank pin. This arrangement, together with a counterweighted crank, tends to eliminate vibration and insures a steady torque at the spindle. Each of the three cast-iron cylinders is separate from the aluminum case and each is interchangeable. The valve, crank, and spindle are made in one piece, so that there is no intermediate valve or spindle driving mechanism subject to wear. The valve cannot get out of time. The crank spindle is supported by three sets of ball bearings which keep the valve from bearing on its bushing.

Grinding wheels for these machines have a 6-in. face, a $\frac{9}{16}$-in. arbor hole, and a diameter of $2\frac{1}{2}$ in. They are made in two different grits and grades. The weight of the tool with the grinding wheel is $16\frac{1}{4}$ lb., the average free speed is 6,000 r.p.m., and the overall length is $23\frac{1}{4}$ inches.

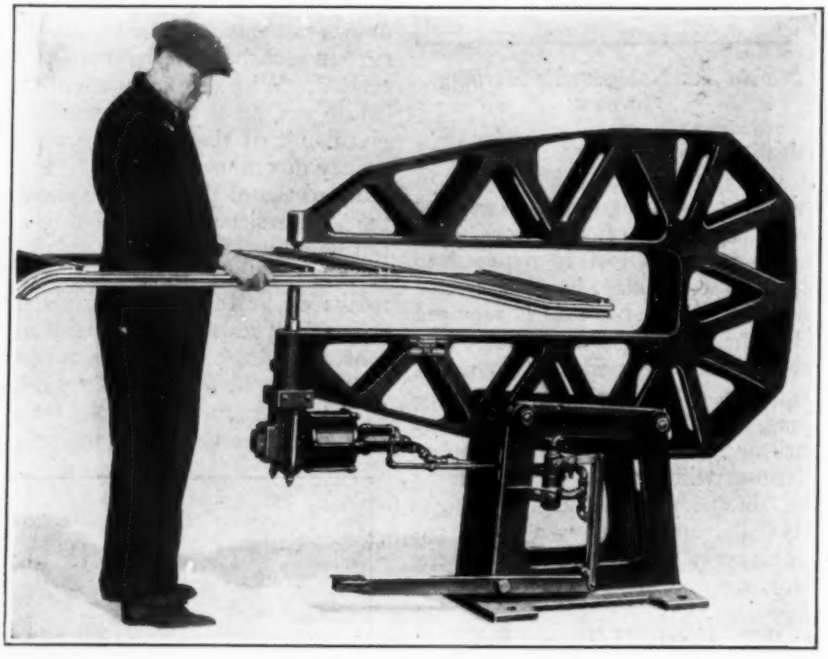


*Ingersoll-Rand Size 63 Air-Driven Rod Grinder*

## Hanna Aircraft Frame Riveter

The increasing use of duraluminum rivets in aircraft and motor-coach body construction has caused the development of this riveting machine by the Hanna Engineering Works, Chicago, Ill. The machine is shown heading over rivets in a bulky frame. Notice that the reach of 48 in. materially assists in extending the machine's radius of action over a considerable portion of the piece being worked upon. The 10-in. gap permits entering work with wide flanges between the jaws for riveting operations in the central portion of the web. When the ram is operated under an air pressure of 100 lb. per sq.in., and with a die stroke of $1\frac{1}{2}$ in., $\frac{1}{4}$-in. rivets can be driven easily. A ram speed of 60 strokes per min. is possible. The pressure exerted by the ram is predetermined and is uniform for a considerable portion of the stroke, resulting in a correctly driven rivet regardless of variations in the thickness of the parts.

The rivets are inserted with shanks down. With the machine arranged with the dies placed vertically and the ram cylinder on the under side, as shown, the rivets are headed over on the underside of the work. Rivets may be inserted well in advance of the riveting, so that interruptions to insert rivets are reduced to a minimum, and consequently the operation of the riveter becomes almost continuous. The machine is operated by a foot-actuated valve thus leaving the workman's hands free to handle the work. This equipment is being offered for either portable or stationary use.



*Hanna Aircraft Frame Riveter*

# NEWS OF THE WEEK

## Uniform Cost Accounting Methods Discussed by Machine Tool Builders

*Next machine tool exposition to be held in 1929*

UNIFORMITY in cost accounting procedure in the machine tool industry was brought considerably nearer to realization by the action taken at the twenty-sixth spring convention of the National Machine Tool Builders' Association in Chicago, May 22 and 23. The engaging of a qualified cost accountant to be attached to the staff of the general manager of the association was voted after strong recommendations to this end had been made by the president of the association, P. E. Bliss, president of the Warner & Swasey Co., the general manager, E. F. DuBrul, and the cost accounting committee. The accountant will work under the committee's direction. It was also voted to hold the next machine tool exposition in 1929, and the president was directed to appoint a committee to conduct it.

The engaging of an engineer to promote the standards work of the association was also considered but it was decided that the time was not quite ripe for this action. It was voted, however, to authorize the necessary expenditure for dues to the American Engineering Standards Committee and for the carrying on of certain other necessary committee work.

### President Bliss' Address

In his presidential address Mr. Bliss reviewed the problems facing the members and appraised some of the opportunities available to them. Among the problems mentioned were: Excessive amount of free service demanded; difficulty of absorbing the cost of design changes in the small amount of business placed at a meager profit, losses occasioned by excessive allowances for old equipment. Mr. Bliss commented on the very few complaints of unethical practices that had been heard, which he took as evidence of the general acceptance of the Code of Ethics adopted by the association several years ago.

Speaking of opportunities before the industry, Mr. Bliss said: "Undoubtedly there are economies of many sorts of which we have not taken full advantage, and probably no one of these is more likely to result in substantial savings than that of re-equipping and re-tooling our own shops, basing our decision on those arguments which we commonly use with our customers, to profit through replacement. It has been said to me by a number of our members who have visited quite a widespread group of our shops, that although some of the companies, both large and small, have made notable progress in this direction, too large a proportion of us has either only nibbled at the idea or have stopped far short of the profitable point. Surely we should be willing to accept for ourselves the advice which in all sincerity we are giving to our customers. Impartial studies made of individual companies would also undoubtedly show opportunity for either reduction in selling costs or a more profitable use of the money spent in that direction. I think it can be honestly said that in our merchandising we have as an industry been less competent than we have been in designing and producing our product; and so I commend to you gentlemen studies of this subject in order that we may, so far as it lies within our ability, improve our situation through savings and a better direction of our expenditures.

### Standardization

"In our general sessions I think we may very profitably consider those subjects of standardization of dimensions of certain parts, materials, etc., which are applicable to our industry at large. Some effort has been made in this direction, but the subject is one always full of fruitful opportunity. You have all had put before you from time to time of late information showing the remarkable strides that German industries are making in this direction, and you will have observed that this has come about more largely as the result of industrial cooperation than through any outstanding achievement of individual concerns.

"On several other occasions during a number of years past, earnest appeals have been made to our members to adopt some standard cost accounting procedure. The ideas presented on these various occasions have seemed to most of us very sound and promising of increased earnings if adopted. Unfortunately, with the exception of a few concerns, there is no information at hand to indicate that our membership generally has made any appreciable use of the methods suggested. I have given more than ordinary thought to this subject, trying to determine why such apparently sound suggestions were not quite generally adopted. I have concluded that it must be the result of at least two things: One, the subject has not been followed up in a sufficiently vigorous and detailed way, and, two, there has not been available to our membership a competent and disinterested person who could come in and counsel with us as to the fundamentals of such cost accounting and as to the means of adopting and applying those fundamentals to the problems of the individual concern. I, therefore, ask this convention to give serious consideration now to the subject of employing such a competent, disinterested cost man, whose sole function, under the direction of our general manager, should be to travel among our membership, not with the idea of installing systems for them, but with the dual purpose of stimulating them and of counselling with them. I have many reasons to believe that such a man, so employed and cordially received by our members, could save for th industry infinitely larger sums than he would ever cost our Association.

"I do not believe we are ready just now for the employment of a second man, although I believe he could be used with equal, if not greater, advantage. This man I have in mind would devote his time solely to propagating the idea of group and industry standardization; he would be a man on whose experience and judgment all of us could draw for an analysis of the principles, and for instruction in their application to our respective businesses.

### More Statistics Needed

"There also undoubtedly remains for us a very considerable opportunity in building up the statistics of our industry. We have never measured up in our response so fully as we might have done and probably could have done profitably. I suggest this subject to you also for your further consideration. I think probably all of us have found on many occasions that we know too little about our industry at large, and about its relationship, profit-wise and otherwise, to other national industries.

"As I have been meeting you gentlemen within our industry and a number of customers of our industry, there have frequently been brought to my attention some of the results already obtained from our Association advertising, and there have been more frequently pointed out some of the probable benefits which would accrue to us if this industry advertising and publicity program were not only continued but widened as to its scope. I am sure that a number of customers of our industry whom I have met and who have commented on this, have been considerably impressed with the ideas that our publicity committee has exploited. I think a wider distribution of these ideas would be helpful."

Particular attention to the question

of uniform cost accounting was given by General Manager DuBrul in his address. He quoted figures to show that the practice in handling certain factors varied widely, very few concerns following the recommendations made in the Scovell-Wellington report of 1921. Summing up, Mr. DuBrul asked, "Should we continue this work on cost accounting, as an association? If improvement of method is actually desirable, then we ought to do something to really achieve this uniformity that we have approved by vote. Experience of other associations shows that there is only one way of getting uniformity. That is to put somebody on the job of patrolling the industry, of boarding the accountant and the executive right in the den of their own offices, getting them to see that the principles advocated are correct in practice, dispelling the ignorance of the ordinary accountant who has never tried these principles, showing up the bugaboos with which he scares the executive.

### Methods Are Practical

"Executives of companies who are successfully using the methods recommended by our Association can and do certify that they find these methods to be practical. Such men would not go back to methods which have not produced the kind of information that the industry ought to have."

Mr. DuBrul reported the deaths of William F. Bockhoff, president of the National Automatic Tool Co., and L. Stock, secretary of the Lodge & Shipley Machine Tool Co. Appropriate resolutions were passed.

Introduced by E. P. Welles, chairman of the committee on relations with the Department of Commerce, W. H. Rastall, chief of the Industrial Machinery Division, called the attention of the members to the dominating position held by American machinery manufacturers. According to a recognized German authority 57 per cent of the machinery built is built in the United States, 13 per cent in Great Britain and 13 per cent in Germany. The production of the American workman is 4½ times that of the German workman, an advantage that is only partially offset by the fact that he gets three times the wage. On the other hand, with but few exceptions, American machinery does not secure anything like a proportionate share of foreign business.

Recommendations of the standards committee approved by the meeting included: Standardization of shaft diameters, of electric motor dimensions, of milling machine spindles; a study of the vise jaw project; the expediting of the drafting room practice project; and steps to develop test codes for various types of machine tools.

Two formal papers were read. One was by Ralph E. Flanders, manager, Jones & Lamson Machine Co. on the subject "What is the best basis for executive policy in making prices?" (It will be abstracted in an early issue). The other was by J. R. Porter, president, Marshall & Huschart Machinery Co., Chicago, and was entitled "Trading old tools for new—a method of handling appraisals for trade-in deals."

Mr. Porter painted a graphic picture of the trade-in evil and then explained how it is being met in three districts where the appraisal system has been adopted, Chicago, New York City, and the Middle New York region. In Chicago, "We have selected as an appraiser one who is known as a strictly second-hand dealer in machine tools, and not competitive to us on any new equipment. We have blank forms which are carried by the salesmen, and when a customer offers a second-hand machine to be taken in trade, the salesman fills out this form to the best of his ability, and it is submitted to the appraiser, who at his own discretion, makes a buying offer to us from the report given him, or in some cases, from inspection. This price is offered by us to the customer, and is absolutely adhered to. The second-hand appraiser has agreed to take any and all machines on which he sets a price from us at the price of appraisal made by him. However, should we elect to retain the second-hand machine for ourselves, we are to pay to the appraiser 10 per cent of the appraisal price. In the event that the price submitted on any machine to us by the appraiser in our judgment is not a fair price to the customer, we reserve the right to raise the price, and in the event the deal is consummated, the appraiser receives no recompense for his services on this deal. However, if the appraiser's price is raised by us, it is understood that we are willing to take the machine at the price which we have set, regardless of whether we ourselves secure the order for the new machine.

"It is my understanding that the other Chicago dealers who are using the appraisal plan have selected the same appraiser as used by us.

"The plan on the whole is being generally accepted by the trade as good business and has largely eliminated the necessity of the mechanical department arguing with the purchasing department regarding the equipment which they have selected on account of the allowance for the second-hand trade-in, and at the same time has speeded up the ordering of the equipment.

"Some of the advantages of the appraisal plan are that it eliminates the necessity of salesmen dickering with the customer on the price of second-hand machinery, thus saving time and energy. It also eliminates the former custom of the salesman endeavoring to sell his own sales manager second-hand machines at prices that are higher than they could be resold at a profit.

"In New York City and in middle New York State, they have done practically the same thing. They happened to select the same second-hand house located in Albany. The New York operators resort to the appraiser for prices when certain classes of machines are being sold, and the middle New York State operators resort to the appraiser on everything excepting certain classes of tools on which competitive sales conditions make it impossible for dealers to limit their offers for second-hand machines; for no dealer can tie his own hands, to the detriment of his manufacturer's best interests."

# Economic Conditions in France Still Unstabilized

## *Foreign trade balance shows decided falling off*

By Our Paris Correspondent

TWO indications suggest that the French situation is by no means stabilized or even progressing as favorably as was hoped from recent returns. The elections the last of April gave Monsieur Poincaré a sweeping victory, but in spite of this he will have to remake his cabinet to take into consideration the various parties of collaborators in the new chamber and senate. This means coalition, if he is in any way to carry out his policies. The country evidently agreed as to his interior policies, above all as to his methods of having saved the franc from a debacle, but his position is by no means so secure with respect to foreign affairs. For the moment he has apparently again shelved the question of revaluing or even stabilizing the franc owing to the uncertainty of a satisfactory settlement and ratification of the American war debt during the American electioneering period and also because of the possibility of a rearrangment of the provisions of the Dawes plan.

Another damper on the situation is the notable deficit in foreign trade balances to the detriment of France. The export of French manufactured goods is shrinking rapidly. Most clearly visible in the monthly averages since the first of the year is the drop in exports of automobiles. Such exports were valued in 1928 at but 90 million francs as compared with 130 million in 1927. Imports, on the other hand, doubled during the same months, soaring above the two million mark.

The first quarter's foreign trade balances showed a falling off to the extent of 211 million francs to the discredit of France, while a year ago for the same period they stood 700 million francs to the good. January imports from the United States dropped 256 million francs and exports to the U. S. fell 52 million francs. German exports to France also fell off, those of Great Britain remaining stationary. Exports to Germany increased, but to Great Britain dropped amazingly—157 million francs. This situation would seem to suggest that Germany was buying in the

cheapest market certain non-standardized, small production goods, those articles *de luxe* for which France has ever been famous.

Unquestionably France is making some headway with the export of agricultural machinery as well as electrical machinery and electric equipment for automobiles. It may be taken for granted that for the most part these go to French colonies and protectorates, mandate countries and those of Central Europe with which she has made economic alliances. The export of pneumatic tools, boring machinery, woodworking machines and small machine tools for metal working has notably increased, implying that French production has also progressed. These facts are not to be denied, but it does not by any means free France from the dependence upon the United States for high-production machinery and tools, though the reparations account of Germany is always encroaching on this market.

As to the value of the French farm machinery market for American manufacturers, last year's import figures reached a total of above 7 million dollars, that going to Italy being 4 million dollars in value and that to Soviet Russia 6 million dollars. France, then, still stands at the head for absorption of American product in this line.

It is commonly believed that France has made great progress in tool and machine equipment in its metal transforming plants, but on the statement of M. Citroen it costs the French manufacturer 500 labor-days to produce an automobile while in the United States it takes but 50 labor-days. The figures, coming from such a source, would appear to be beyond dispute.

Monsieur Leon Guillet, before the French Academy of Sciences, has described a new "nitrated" steel which has remarkable qualities for resisting friction. With adequate lubrication it is almost frictionless at any temperature less than 500 deg. C., a higher temperature than is to be found in the cylinders of an internal combustion motor.

### Forgings in Demand

Forgings and stampings are in moderate demand by the railway companies and automobile manufacturers, but this situation is merely seasonable. Nuts and bolts are in demand by railways and steel buildings construction, but the small trades are not accumulating stocks, though prices are low as compared with the cost of semi-manufactured rods.

Machine tool makers are feeling German competition in the form of reparations payments in kind but the high tariffs now in force on mechanical tractors are giving impetus to the development of this industry by French firms who are equipped to produce in any but the smallest quantities, it being implied that the successful methods employed are those which have been adopted in the automobile industry.

There have been some orders placed during the past month for railway rolling stock and the P.L.M. railway is still planning for 250 new locomotives during the year. Since a year ago French railways have made up their list of needs for the next ten year period and it is probable that this branch will find a steady run of orders for some time to come, though delivery dates are not likely to be rushed.

Wire nails, barbed wire and galvanized wire are firm in price; indeed, in some respects they rose to the extent of 5 francs per 100 kg. Progress has been made by French manufacturers in putting out wire fence ready for use in various standard lengths.

In an appeals court decision at Paris certain adding machine patents originally of American proprietorship have been allowed to lapse in France by reason of the right thereto not being taken advantage of by complying with the manufacturing clause or by their having been ceded to French firms. The point is of importance with respect to the future of all American mechanical *brevets,* or patents, which may fall into a like situation. The French concern that had actually adopted these features turned around and sued the makers of an American-made imported product for having incorporated them in machines that they were selling on the French market. Damages of 800,000 francs were secured as "tending to impair the business of the French concern." There is no mystery about the situation; it simply stands as an oversight on the part of the original American owners.

### U. S. Financial Domination

Some economists here seem to think that the American financial grip will one day let up in favor of an economic grip from which France (and various other European countries) may not escape; that is, one obtained by the acquiring of industrial stocks by American investors. Louis de Launay of the French Academy of Political Science, recently returned from America, states that this material superiority of America will unfortunately endure for all time.

France takes keen delight in reiterating the fact that cast-iron pipe manufacturers here are still able to sell their product in the United States, citing, apart from export statistics, the statement of the president of the U. S. Cast Iron Pipe and Foundry Co. to the effect that the situation cannot be helped as French labor costs remain 50 per cent or more below those of America in the industry.

French metal-working industries in all lines are forever claiming a high tariff protection, but this is generally understood to provide the means of paying high taxation and overhead charges rather than in increasing wages, as is obvious when total costs are dissected. This is perhaps more in evidence with respect to product intended for general utility and consumption than with machine equipment for manufacturing, where the best that can be had regardless of price, is so often the cheapest, but the two issues are not very widely separated however.

During the fifteenth week of this year car loadings were but 381,879 as compared with 418,939 in 1927 and 453,345 in 1926. No week last year stood at so low a figure as the present.

Unskilled labor in the Paris engineering trades is paid at the rate of 0.65 gold francs per hour as compared with 0.55 in 1914, which compares with 1.16 gold francs equivalent as the London wage, with 0.80 francs for Berlin and 0.63 francs for Milan. The French wage scale is thus shown as being under that of any other of the great industrial countries of Europe.

The workers' food budget, based on the typical "basket of provisions," which the International Labor Office at Geneva has worked out, approaches but 50 per cent of its pre-war amplitude, as compared with an average wage increase of two gold francs per day, a sum which by no means takes care of the rise.

A recent Franco-Swiss customs agreement brought about some changes on items which might have affected the status of the United States products in France, but the government acceeded to the suggestion and brought them down to the old customs level as provided for by the *modus-vivendi* which was arrived at by the United States and France last November. This shows at least a disposition on the part of the French government not to contravene the most-favored-nation clause, though it leaves open the matter of contingent quantities of certain goods. Prohibitions and contingents of imports and exports, however, were distinctly *not* recommended by the Geneva international economic conference last year.

Price index figures show no improvement, those of last of April being practically stationary at high levels—589 for minerals and metals, and 674 for industrial materials in general. Food stuffs have actually advanced to 593 from 556 in January and the general index stands at 636 as compared to 620 in January. Living costs for the workingman's family of four are 507 for Paris.

## Coolidge Signs Merchant Fleet Bill

Release of the government from the burden of the merchant marine fleet was predicted upon the signing of the Jones-White bill by President Coolidge on May 23. The chief provision of the bill is its increase of a revolving fund of $250,000,000, which will be made available to private shipping interests on long-time notes to advance construction programs. Another allowance which is due to revive shipping construction to a great extent is the long-time provision for repayment to the government and the extended interest privileges.

With fifteen services, which have 300 vessels in operation still under government control, the bill's provision that five of the seven members of the Shipping Board may dispose of these ships to private interests as they see fit practically puts the government fleet on the block.

# *The Business Barometer*

## The outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE

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WHEN the diagnosticians had all concluded that something unusual was required to check the boom in the securities market, the Stock Exchange itself furnished the restraint needed by closing on Saturdays and adjourning at 2 o'clock on the other days of last week. This left only twenty trading hours in the whole week and the sedative effect was immediately apparent. The volume of business was much reduced and a sharp decline in many speculative issues ensued.

But there was an orderly recovery on Thursday and Friday, and as the equipoise of the market appears to have been re-established the governors of the Stock Exchange have decided to keep it open as usual (except on Saturdays) until further notice. Probably it will soon be reopened on Saturday, for the community seems to have been sobered by the week's experience and brokers are demanding margins that compel even the reckless to be circumspect.

The growing tightness of money as evidenced by the higher rates paid for both time and demand loans, the continued export of gold, the action of the Interstate Commerce Commission in the matter of the so-called Van Sweringen consolidation, and the President's veto of the McNary-Haugen bill, all provided food for thought and helped to make the public cautious.

It is of course possible that caution may again be thrown to the winds, but it is difficult for a boom that has lost its momentum to recover it, and there is much to indicate that a period of gradual liquidation is approaching in the stock market.

It is hard to say in just what quarter this liquidation will first be manifest, but there are many who think that railroad stocks are selling on a basis that reflects the hope of consolidation plus good earnings, and that it is quite possible they may decline when the obstacles that the Interstate Commerce Commission has put in the way of all the railroad mergers thus far proposed are fully realized.

But except as it may wipe out paper profits a reversal in the trend of the stock market will do no harm, provided it is so gradual that it does not cause a shock or bring any revelation of rottenness that will disturb confidence.

As yet it is too early for the effect upon distributive trade to be apparent, and hand-to-mouth buying in small quantities is still the rule rather than the exception. For this the manufacturers and their representatives may be partly to blame, for the cry of overproduction is to be heard at all their gatherings and it is only natural that the buyers should hold off when sellers tell them that the market is oversupplied.

Despite the everlasting talk of saturation the automobile industry continues to expand and the production of cars and trucks for the first four months of 1928 shows an increase of 3½ per cent over 1927. These figures are really surprising when the comparative inactivity of the Ford Co. is considered.

In other lines of business there is not much change. The steel mills in the greater Pittsburgh district are running at only 75 per cent of capacity, but there has been no reduction in the Chicago territory and the trade authorities appear to be satisfied with the outlook.

Copper is still very firm. The demand from those who manufacture electrical appliances seem to have absorbed the surplus production.

The increased use of electricity also offers a partial explanation of the overproduction of coal and oil.

These appear to be the incurably sore spots in the economic body of the United States and partial excision may be the only remedy.

On the exchanges where commodities are bought and sold for future delivery comparative quietude has prevailed. Wheat has advanced upon unfavorable weather and the hope that some farm relief measure may be yet adopted despite the President's veto of the McNary-Haugen bill.

The only important foreign news of the week comes from China and it is hard to understand. According to the latest advices the Northerners appear to have been able to hold Pekin against the Southerners or Nationalists.

The hope of a central and unified government for China is, therefore, still deferred, but it is believed that Japan favors the Nationalists and that her moral support makes their ultimate success likely. Tranquility in China is certainly to be desired and its attainment would mean much to the world's trade as well as to the three or four hundred millions who inhabit the presently misnamed Celestial Empire.

In England as well as in Continental Europe conditions seem to be improving and the summer promises to be one of great prosperity.

The same thing might be said of the United States if we were sure that the stock market could be unwound without developing some weakness or fracture in the financial machinery that has been under such strain. Perhaps it will be well to wait a few weeks more before assuming that this can be done, for the inexperienced have put an enormous amount of money into Wall Street, and its loss might seriously affect the purchasing power of the country.

Some inkling of what has been going on may be had from a statement which shows that the deposits in the savings banks of New York City declined by $14,308,000 during the month of April. Savings bank authorities attribute it to withdrawals made for investment in the stock market.

## WHAT'S DOING IN INDUSTRY

**MAY business in machine tools and allied lines will about hold its own or be slightly less than that of April. In Cincinnati a slight let up in orders has been noted in the past week by manufacturers, but local agents report an increase in the volume of business. Enough orders are on hand, however, to keep the factories busy for some time. In fact, one of the problems just now is to meet early delivery dates. In New York orders have fallen off in the past month, but there is considerable optimism apparent.**

**RAILROAD buying is disappointing in many centers, particularly in New York and in the Indianapolis district, where it has been curtailed to a minimum. In New England activity in this field is increasing, as it is also in Canada.**

**IN THE Dominion, May is expected to prove an exceptionally good month. The automotive industry is at a high peak, steel production is breaking records, construction activity is the highest it has ever been, and machinery sales have risen accordingly. Contractors' equipment also has been selling well in the South in the larger cities, but the market for this class of machinery has been poor in the Middle West.**

**TEXTILE machinery sales are unusually high in the South and the outlook for continued business is good. Woodworking machines also are selling well here, as they are in other centers. Automotive buying continues to dominate the Detroit and other markets in machine tools, and recently aeronautical engine shops have been running a close second.**

# *The Industrial Review*

## Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future.

### SOUTHERN DISTRICT

Though machinery and machine tool sales in this district during the past two weeks have not been as active as during the first three or four months of the year, as a whole, business compares very favorably with the corresponding period last season, and continues better than distributors had expected earlier in the year.

The textile industry, because of the erection a number of large new plants in the southeastern territory, has been a particularly heavy buyer of machinery lately, and some unusually large sales have been made in this field. The volume of business has been fully as large as it was last season in spite of the fact that the first half of 1927 was one of the best periods in the history of the business in this particular field. Furthermore, the outlook for the next few months is also very good.

Woodworking machinery also continues in heavy demand in the Southeast, mainly in the furniture and millwork field, but distributors in Atlanta state that sales have declined somewhat since the first of May, but that they look for about normal business through June.

Some of the larger railroads are erecting new shops in this section, and sales of heavier equipment in this field are also reported good.

On the other hand, distributors of garage and service station equipment state this business is unusually quiet, and that used or rebuilt equipment is about all that is being purchased, while sales to smaller machine shops are also reported quiet. Road-building machinery is fairly brisk but no better than at this time last year, while sales of building and contractors' equipment are larger than last year in the larger cities like Atlanta, Birmingham and New Orleans, but only about normal in other districts.

### INDIANAPOLIS

Little change is noted in the demand here for machinery or machine tools. The situation remains considerably spotted, with no immediate prospect of a change, but all told the first five months of this year will show a slight improvement in volume over the same period of last year. With the coming of spring and the building season, the demand for contractors' equipment has been rather disappointing. Last year at this time there was a good demand for this equipment. This year, while there is a scattering demand, the volume is not what was expected. A slump in construction, both in the building and road field, is given as the cause.

A fair demand for machine tools continues to come from the automobile industry. Most of the Indiana factories have maintained their production schedules, but just now they appear to have purchased their immediate requirements. The railroad demand for machine tools has been distinctly disappointing up to the present time. Most of the roads have curtailed their buying to a minimum and some have been laying off shop men with painful regularity. It is predicted in these cases that the men so laid off will not be reinstated until perhaps the last of August when the roads prepare for the winter season. The same situation prevails in the interurban field. These latter companies, however, need considerable work done, but generally are so poor they cannot afford almost necessary repair work.

A fair demand for special machinery is coming from the woodworking industry, particularly the flooring and interior finish mills, but the volume is not normal. The demand for similar machinery from the furniture factories is very light as compared with last year.

One rather bright spot is the electric field, where many replacements are being made and where new installations also are rather common.

### CANADA

The month of May has been an exceptionally good month for machinery and machine tool manufacturers in Canada. The advent of more seasonable weather has brought about a greater demand for structural machinery and mining equipment, while the railroads have also become more active in buying material.

The automotive industry is working at full pressure and indications are that an unusually active season lies ahead. A considerable number of plants producing parts and accessories are very busy, and some announce extensions to plants and the establishment of new factories.

Consumption of practically all lines of iron and steel is high and plants throughout the country are working at or close to capacity. Production of steel ingots and castings in April amounted to 112,780 tons, as compared with 109,107 tons produced in April, 1927. For the first four months of the current year production was 414,153 tons, an increase of 26 per cent over the 330,659 tons produced in the corresponding period of last year.

The construction industry is at the highest level in the history of the Dominion. In every part of the country there is an active program of the class of building which calls for large quantities of iron and steel.

Of particular interest to the metal-working industry generally was the official statement that the Algoma Steel Corporation expected to spend about $12,000,000 within the next two or three years on extensions, involving the construction of three new plants at Sault Ste. Marie, as well as a number of improvements to the existing plants.

### CHICAGO

Market conditions in the machine tool industry continue on practically the same level as for the last two weeks. While some concerns report a slight gain in business, others say that the month of May has not shown much, if any improvement over April. If a general average were struck, it probably would be found that the machine tool market is more than holding its own as the year advances.

Present demand is largely for standard tools, with grinders, screw machines, lathes of various types and planers selling the most freely. Small, electrically-driven tools, which have had a most satisfactory sale for the last several months, still are called for in good volume.

No new railroad lists are reported, buying, as for some months, being light. Industrialists are inquiring for diverse equipment, principally however for used tools, which they seek to buy at figures far below those asked for new machinery. Dealers are carrying heavy stocks of used tools, and in most cases are able to come to terms with prospective buyers, although facing keen competition. The trend of the machine tool business as gathered from talks with manufacturers' representatives and dealers, is slightly, though not markedly, upward.

### DETROIT

While there is a very slight slowing up in the demand for machinery and machine tools in Detroit, the change is not particularly noticeable and is not considered significant. Many substantial orders are coming in for a variety of equipment. Inquiries have not diminished to any great extent and the general prosperity of Detroit and Michigan is far above the average.

The Ford Motor Co. is making every effort to step up its production and it seems likely that a big jump will be made in the near future. A great deal of work is being farmed out in an effort to take care of the demand for cars. This policy will probably continue for some time as the company seems to be increasing its own capacity with more precision and pains than speed.

The demand for automobiles continues to grow and most of the local companies are making consistent production records. May stands up well with April and the earlier months of 1928 both from the standpoint of automobile sales and the sale of machinery and equipment.

While no predictions can be made at this early date, it seems likely that the general prosperity of the trade will continue through the summer and probably through the year.

### CINCINNATI

The majority of the machine tool manufacturers in the Cincinnati district report that in the past week there was a slight falling off in sales. The recession is regarded as merely temporary, however, and it has not caused any alarm. A small number of manufacturers report a slight gain in the week and a few report that they held their own.

Sales agents express a feeling of encouragement, stating that they did better than to hold their own in the week in the matter of sales, and at the same time developed an increased number of prospects that they regard as excellent.

Enough orders are being booked by manufacturers to maintain production at its present high level. The orders received were well diversified and came from all sections of the country, single items predominating.

A slightly-increased amount of buying was done by makers of automobiles and concerns in the allied industries, but none of the orders were large. Railroad buying also was confined to single tools and replacements.

Inquiries came in freely during the week from miscellaneous users. Although these were almost altogether confined to single items, the aggregate requirements are regarded as a strong indication that a much better market is developing.

### NEW ENGLAND

Added inquiry from the railroad industry has brightened the New England market, and gives encouraging promise of brisk buying in this somewhat latent field. The Boston & Albany and the New Haven road have circulated lists among machine tool builders for a substantial number of items, but placements thus far have been restricted to an occasional tool. Requirements of New England roads, and outside

roads among the prospective buyers, now number twenty or more tools and include a variety of lathes, a radial drill, end shears, and a universal automatic grinder. Representative manufacturers however, believe the railroads are holding off until after the June meetings of the American Railway Association.

Industrial conditions have been improved by a strong demand for parts from the aeronautical industry. The Billings & Spencer Co. of Hartford, has a large volume of orders for drop forgings to go into the Wasp and Hornet airplane engines made by the Pratt & Whitney Aircraft Co. It is estimated that upwards of fifty plants in leading Connecticut cities, alone, are manufacturing parts for this industry. In Bridgeport, fifteen manufactories are making plane parts. Machine tool builders begin to feel the influence of this industry, and a substantial business is expected.

The General Electric Co. has been awarded contract to supply electric equipment for the complete electrification of the Boston, Revere Beach & Lynn railroad. The Goss & Deleeuw Machine Co. of New Britain, is well supplied with orders and has increased schedules.

### NEW YORK

Although machine tool sales in the New York district in May have not been up to the volume reached in March and April, there is still a very optimistic feeling among dealers and factory representatives looking to the maintenance of a fair amount of business for some time to come. While no large lists have been placed recently, a steady volume of orders for one or two tools has kept the market active. As in other centers, buying is as needed, and except for such plants as the Wright Aeronautical Corporation, where rapid expansion is taking place, replacement of old equipment is being carried on slowly. That shops are busy in this territory is indicated by the fact that small tools and grinding wheels are selling in quantity.

There is still a hesitancy on the part of some buyers to place orders, even where equipment is obviously needed. This situation is particularly true of the railroads. The market for machine tools in this field has been discouragingly slow for some time, although sellers are kept keyed up by the occasional issuance of inquiries.

Where last week a noticeable drop in orders and inquiries was noted, there has been a decided gain in the number of inquiries in the past week, although orders are still lagging. While some factory representatives are finding sales poor in this district, in every case they report their factories are working up to full capacity or better. In several instances, a large percentage of the output is going abroad—to England and her colonies, chiefly. South America also is furnishing a profitable outlet at present.

The General Electric Co. continues to lead in purchases in this section. A steady flow of inquiries, followed by quick action, has been noted for some weeks. In recent lists, grinding machines, lathes and presses have been called for. Some of this equipment is for the household refrigerator, production of which has been steadily increasing; others are for service shops, the latest being in Chicago; others for an apprentice school. This company also received an order for three oil-electric locomotives to be built jointly with the Ingersoll-Rand Co. and the American Locomotive Co. The units are for the Ashland division of the American Rolling Mill Company.

Among the machines sold by the Pratt & Whitney Co. in the past week were three tool room lathes, three bench lathes, three automatic lathes, three die sinkers, a jig borer, a 6-in. vertical shaper, a vertical surface grinder and a cutter grinder.

## British Shop Unions Want Piece Rates

The British engineering shop trades have followed the lead of the United States in basing pay on piecework rather than on a flat rate. A resolution was recently adopted by the National Committee of the Amalgamated Engineering Union affirming that as 75 per cent of the union members were already working on such a basis the system should be recognized by the whole union. Hitherto the union had held out stubbornly against payment by results, although the engineering shops throughout England had unofficially put the plan into operation.

## Ford Employs 112,683 Men

With 112,683 men at work, the Ford Motor Co. now has more employees on the payrolls of its Detroit plants than at any previous time in its history, according to figures given out on May 23 by company officials. The peak employment was in the summer of 1926 when the company had 110,000 men working. The employees are distributed as follows: Fordson plant, 75,858; Highland Park plant, 32,111; Lincoln plant, 4,714.

## Western Industrial Association Meets in Denver

The fourth annual convention of the Western Industrial Education Association met in Denver, May 4 and 5. There were present 150 industrial executives and 31 state supervisors and directors of industrial education. Discussions were grouped under the following sections: railroad, sugar, automotive, mining, public utilities, oil industries, plumbing and heating, baking, welding, and lumber. The welding section was presided over by A. G. Odell, director of welding instruction, Denver Opportunity School.

## G.E. Welds Two More Factory Buildings

Two new factory buildings, all the structural work of which will be arc welded, are now being erected by the General Electric Co. One of these will be an addition to the General Electric plant in Bridgeport, Conn., and the other will be located at the company's Pittsfield (Mass.) plant. The first General Electric welded building was erected in Philadelphia as an addition to the switchgear manufacturing plant there.

## Engineering Council Opposes Senate Bills

The executive committee of the American Engineering Council, at a meeting held recently in Milwaukee, reaffirmed its opposition to the Senate Bill providing for the extension of the time limitations under which patents were issued in the case of persons who served in the military or naval forces of the United States during the World War. A joint resolution to amend section three of the joint resolution entitled "Joint resolution for the purpose of promoting efficiency, for the utilization of the resources and industries of the United States," approved February 8, 1919, was also opposed.

This resolution has to do with the so-called Garabed free-energy generator. This question has been before Congress in every session in some form or other during and since the War. The American Institute of Electrical Engineers, from time to time, has urged the Council to vigorously oppose this. The Council's committee on patents has likewise acted. The intent of this legislation, as expressed in bills in previous sessions of Congress, has been opposed by the Council. The resolution has been favorably reported by the patent committee of the House and is now on the House calendar.

## Gray Iron Institute Elects Officers

At its first general meeting held in Philadelphia on May 18, the newly-formed Gray Iron Institute adopted a certificate of incorporation and a set of by-laws. A board of directors was elected and from this number the officers were chosen as follows: President, W. L. Seelbach, Forest City-Walworth Run Foundries Co.; first vice-president, B. H. Johnson, Cresson-Morris Co.; second vice-president, A. E. Hageboeck, Frank Foundries Corporation; and treasurer, H. S. Chafee, Builders Iron Foundry Co. Dan M. Avey, editor of *Foundry*, will continue as secretary-manager. These officers will hold office until the first annual convention to be held this fall.

## Employment Rose in April

A steady increase in the volume of employment in April, which was expected to continue throughout May, was reported on May 20 by the employment service of the Department of Labor. The automobile and allied industries added large numbers of men to their forces, with indications of further increases during the next few weeks. The iron and steel mills were reported as having maintained in April the improved position gained in the preceding month, and plants manufacturing building materials employed additional workers. All outdoor activities increased, absorbing many workers.

## Salesmen's and Purchasing Agents' Association Elects Officers

At a recent meeting of the Salesmen's and Purchasing Agent's Association of America, whose headquarters is at Bridgeport, Conn., the following officers were elected: president, A. H. Jones, Bryant Electric Co.; vice-president, R. T. Phipps, Bullard Machine Tool Co.; treasurer, W. H. Bradley, Hunter & Havens; and secretary, W. B. Osborne, Erie Malleable Iron Co. It will

be recalled that the association sponsored an industrial show in Bridgeport last February. Because of the success of this show it is planned to hold another one in 1929 in the same city.

The annual outing is planned for June 23. It will be held at Champ's Farm, Bridgeport, and it is expected that salesmen and purchasing agents in the New England states will be well represented. A short business meeting will precede the sporting events.

## Railroad Notes

Contract for 1,250 50-ton steel box cars, truck side frames and bolsters for additional equipment for the Chicago, Milwaukee & St. Paul Railroad has been received by the Bettendorf Co., Bettendorf, Iowa. The contract will represent about a $3,500,000 expenditure. Work will be started in June with completion date set for Aug. 1. The Bettendorf Co., in the meantime, is preparing to start upon manufacture of 50 flat cars for the Union Pacific and 100 refrigerator car underframes for Swift & Co.

## Industrial Advertisers to Meet

"Can industrial advertising lower the cost of industrial sales—and how?" will be the theme of the seventh annual conference of the National Industrial Advertisers' Association to be held at the Chase Hotel in St. Louis, June 11-13. A number of men prominent in this field have been selected as speakers. An exhibit is to be held in connection with the conference, and over five hundred panels will be shown. Awards will be made for the best work in ten competitions.

## French Air Mission Arrives

The French Mission for the Development of Aeronautics, composed of twelve members who have been appointed to study civil aviation in different parts of the world, arrived in New York on May 23. The mission is headed by General Paul Boucabeille, and will make an aerial trip across the continent, visiting plants and airports enroute.

## Carbon Brush Simplification Adopted

A sufficient number of written acceptances having been received for Simplified Practice Recommendation No. 56 on carbon brushes and brush shunts, recently revised by the industry, the Division of Simplified Practice, Department of Commerce, announces that the project is now in effect, as of November 1, 1927, subject to annual revision or reaffirmation by the industry. This recommendation provided increments of increase in dimensions, and dimensional tolerances for carbon brushes, sizes of holes or slots in terminals for flexible shunts, and size and specifications for cable for brush shunts.

# Personals

H. O. COE has been appointed manager of the Cleveland office of the United States Electrical Tool Co., 403 Erie Building.

M. L. PRENTIS, treasurer of the General Motors Corporation, of New York, was elected treasurer of the New Departure Manufacturing Co., of Bristol, Conn., at a recent meeting of the board of directors.

WALTER MITCHELL, 1744 E. 22nd St., Oakland, Calif., is now representing the Goddard and Goddard Co., Inc., of Detroit, in the northern half of California.

JOHN CRAIG has joined the sales organization of the Chain Products Co., of Cleveland. He was formerly connected with Walden-Worcester, Inc.

WALTER B. OSBORNE has been appointed Connecticut representative of the Erie Malleable Iron Co., Kondu Division, with headquarters at 121 Mill Hill Ave., Bridgeport.

CHARLES M. SCHWAB received the Bessemer Gold Medal from the Iron and Steel Institute of Great Britain on May 3 for distinguished merit in promoting the metallurgy of iron and steel.

A. A. PAOLI, manager of the Winnipeg office of Ingersoll-Rand Company, for several years past, has joined the firm of Kipp Kelly, Ltd., as manager of the mining machinery department.

S. Z. KRUMM, metallurgical engineer, Buckeye Steel Castings Co., was elected chairman of the Columbus Chapter of the American Society for Steel Treating at the annual meeting of the chapter.

J. W. MEEKER has been appointed purchasing agent of the shipbuilding division of the American Brown Boveri Electric Corporation, Camden, N. J., to succeed L. G. Buckwaller, deceased.

LOUIS E. NELSON, formerly division superintendent of the Warner Corporation, Muncie, Ind., is now connected with the City Machine & Tool Works, and the National Broach Co., both of Dayton, Ohio, in a sales-engineering capacity.

BOYD NIXON has become associated with Louis G. Henes, distributor of machine tools, 75 Fremont St., San Francisco, Calif. He was formerly manager of the Philadelphia office of the Niles-Bement-Pond Co., and the Pratt & Whitney Company.

C. L. STEVENS has been elected president of the Reed-Prentice Co., of Worcester, Mass. Clinton Schneider, works manager, was made a member of the board of directors. F. W. McIntyre is vice-president; C. H. Casell, treasurer, and J. Mackin, secretary.

# Business Items

The Indianapolis Screw Products Co. of Indianapolis, Ind., has filed papers increasing its preferred stock $40,000.

Foote Bros. Gear & Machine Co., of Chicago, has appointed the Cunningham Electric Co., 2123 Pacific Ave., Tacoma, Wash., its representative in that district.

The Ramsey Chain Co., Inc., of Albany, has opened a branch office and warehouse at 548 Spring St., North West, Atlanta, Ga. W. H. Davis will be in charge.

The McMyler-Interstate Co., of Bedford, Ohio, manufacturers of conveying equipment and cranes, has moved its New York office from the Woolworth Building to Room 1,710, Grand Central Terminal Building.

The Wright Flexible Axle Motors, Ltd., have purchased the property formerly occupied by the Canada Carriage and Body Co., in Montreal. It is proposed to use the property for the production of the company's new car.

Black & Bigelow, Inc., 551 Fifth Ave., New York, N. Y., was recently formed to render engineering and business service to manufacturers and operators of aircraft. Archibald Black is president and general manager; Anson A. Bigelow is vice-president.

The Fokker Aircraft Corporation will open its second plant, near Glendale, W. Va., in the near future. The factory contains about 100,000 sq.ft. of floor space. The additional facilities have become necessary to fill orders on the books, which are far in excess of the present manufacturing capacity.

The Dedman Foundry & Machine Co., Houston, Tex., an established concern, has recently incorporated the business with a capital stock of $160,000, and is planning to carry out an extensive improvement program this year, it is announced, considerably increasing the capacity of the present plant.

The Fulton Iron Works, of St. Louis, has purchased the Foos Engine Co., of Springfield, Ohio, manufacturer of Diesel engines up to 300 hp. The St. Louis company has been making engines up to 2,000 hp. for some time. The Foos company has a net worth of about $500,000, it is stated.

The Spartanburg Textile Machinery Co., Spartanburg, S. C., according to a recent announcement, has recently acquired the plant of the American Machine Shops, also of that city, and is installing equipment for the manufacture of textile plant machinery and equipment, including gears, cams, pulleys, brake wheels and textile machinery parts.

# Forthcoming Meetings

**American Railway Association.** Schedule of sectional meetings: Division V, mechanical, June 20 to 27, Atlantic City, N. J.; Division VI, Purchases and Stores, June 20 to 22, Atlantic City, N. J.; Division VII, Electrical, Sept. 22 to 28, Cleveland, Ohio. J. W. Welsh, secretary, 292 Madison Avenue, New York City.

**Association of Iron and Steel Electrical Engineers.** Annual meeting, Stevens Hotel, Chicago, June 25 to 29. J. F. Kelly, managing director, Empire Bldg., Pittsburgh, Pa.

**American Society for Testing Materials.** Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 25 to 29. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

**Society of Automotive Engineers.** 1928 Summer Meeting, Chateau Frontenac, Quebec, Canada, June 26 to 29. C. E. Heywood, in charge of meetings, 29 West 39th St., New York.

**Canada's Steel and Power Show.** Second annual show to be held at the University of Toronto Arena, Sept. 4-7. Secretary, Campbell Bradshaw, 24 Front St., Toronto, Ontario.

**American Railway Tool Foremen's Association.** Annual meeting, Hotel Sherman, Chicago, Sept. 12, 13 and 14. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

**American Railway Tool Foreman's Association.** Sixteenth annual convention of the Supply Association, Hotel Sherman, Chicago, Sept. 12, 13 and 14. F. A. Armstrong, secretary, the Pratt & Whitney Co., 564 W. Monroe St., Chicago.

**National Safety Council.** Seventeenth annual safety congress will be held in New York, October 1-5. Idabelle Stevenson, executive secretary, 1 Park Ave., New York.

**American Society for Steel Treating.** "National Metals Exposition," Commercial Museum, Philadelphia, Pa., week of Oct. 8. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

**American Gear Manufacturers Association.** Semi-annual meeting, Statler Hotel, Buffalo, N. Y., Oct. 11-13. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

# The Weekly Price Guide

### *Rise and Fall of the Market*

PRESENT quotations on pig iron are the lowest in thirteen years. Scrap iron and steel prices also tend downward. Finished steel, however, holds at $1.85 per 100 lb. for bars, shapes and plates in large mill lots at Pittsburgh. Steel mill operations average 82 per cent of capacity as against 84 per cent last week and 80 per cent a year ago. Most of the present steel demand is for pipe and automotive bars. Structural steel sales for April amounted to 236,250 tons, compared with 258,750 in March and 262,500 for April, 1927, according to latest reports of the Department of Commerce. Fabricated brass and copper together with scrap brass and copper are higher than a week ago at principal distributing points.

*(All prices as of May 25, 1928)*

## IRON AND STEEL

**PIG IRON**—Per gross ton, f.o.b.:

| | |
|---|---|
| CINCINNATI | |
| No. 2 Southern | $21.44 |
| Northern Basic | 20.89 |
| Southern Ohio No. 2 | 21.19 |
| NEW YORK—Tidewater Delivery | |
| Southern No. 2 (silicon 2.25@2.75) | 25.62 |
| BIRMINGHAM | |
| No. 2 Foundry | 16.00 |
| PHILADELPHIA | |
| Eastern Pa., No. 2x (silicon 2.25@2.75) | 21.76 |
| Virginia No. 2 | 27.17 |
| Basic | 21.26 |
| CHICAGO | |
| No. 2 Foundry local (silicon 1.75@2.25) | 20.00 |
| No. 2 Foundry, Southern (silicon 2.25@2.75) | 22.80 |
| PITTSBURGH, including freight charge ($1.76) from Valley: | |
| No. 2 Foundry | 20.26 |
| Basic | 19.26 |
| Bessemer | 21.26 |

**IRON MACHINERY CASTINGS**—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

| | |
|---|---|
| Detroit | 4.50@4.75 |
| Cleveland | 5.00 |
| Cincinnati | 4.30 |
| New York | 5.25 |
| Chicago | 4.50@4.75 |

**SHEETS**—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

| Blue Annealed | Pittsburgh Mill Base | Chicago | Cleveland | New York |
|---|---|---|---|---|
| No. 10 | 2.00@2.20 | 3.50 | 3.25 | 3.90* |
| No. 12 | 2.05@2.25 | 3.55 | 3.30 | 3.95* |
| No. 14 | 2.15@2.30 | 3.60 | 3.35 | 4.00* |
| No. 16 | 2.25@2.40 | 3.70 | 3.45 | 4.10* |
| Black | | | | |
| Nos. 18 to 20 | 2.70@2.80 | 3.75 | 3.55 | 4.00 |
| No. 22 | 2.85@2.95 | 3.90 | 3.70 | 4.15 |
| No. 24 | 2.90@3.00 | 3.95 | 3.75 | 4.20 |
| No. 26 | 3.00@3.10 | 4.05 | 3.85 | 4.30 |
| No. 28 | 3.15@3.25 | 4.20 | 4.00 | 4.45 |
| Galvanized | | | | |
| No. 10 | 2.90@2.95 | 4.10 | 3.80 | 4.25 |
| Nos. 12 to 14 | 3.00@3.05 | 4.20 | 3.90 | 4.35 |
| No. 16 | 3.10@3.15 | 4.30 | 4.00 | 4.45 |
| No. 18 | 3.25@3.30 | 4.45 | 4.15 | 4.60 |
| No. 20 | 3.40@3.45 | 4.60 | 4.35 | 4.75 |
| No. 22 | 3.45@3.50 | 4.65 | 4.40 | 4.80 |
| No. 24 | 3.60@3.65 | 4.80 | 4.50 | 4.95 |
| No. 26 | 3.85@3.90 | 5.05 | 4.75 | 5.20 |
| No. 28 | 4.10@4.15 | 5.30 | 5.00 | 5.45 |

*250 to 3,999 lb.

**WELDED STEEL PIPE**—Warehouse discounts are as follows:

| | New York | | Cleveland | | Chicago | |
|---|---|---|---|---|---|---|
| | Black | Galv. | Black | Galv. | Black | Galv. |
| 1 to 3 in., steel, butt welded | 53% | 39% | 55½% | 43½% | 54% | 41% |
| 2½ to 6 in., steel, lap welded | 48% | 35% | 53½% | 40½% | 51% | 38% |

WROUGHT-STEEL PIPE LIST

| Size, Inches | List Price per Foot | Diameter in Inches—External | Diameter in Inches—Internal | Thickness Inches |
|---|---|---|---|---|
| 1 | $0.17 | 1.315 | 1.049 | .133 |
| 1¼ | .23 | 1.66 | 1.38 | .14 |
| 1½ | .27½ | 1.9 | 1.61 | .145 |
| 2 | .37 | 2.375 | 2.067 | .154 |
| 2½ | .58½ | 2.875 | 2.469 | .203 |
| 3 | .76½ | 3.5 | 3.068 | .216 |
| 3½ | .92 | 4.0 | 3.548 | .226 |
| 4 | 1.09 | 4.5 | 4.026 | .237 |
| 4½ | 1.27 | 5.0 | 4.506 | .247 |
| 5 | 1.48 | 5.563 | 5.047 | .258 |
| 6 | 1.92 | 6.625 | 6.065 | .28 |

**SEAMLESS STEEL TUBING**—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

| Thickness—Decimal | B.w.g. and Fractions | Outside Diameter in Inches—½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ |
|---|---|---|---|---|---|---|---|---|
| | | Price per Foot | | | | | | |
| .035" | 20 | $0.15 | $0.16 | $0.17 | $0.18 | $0.19 | $0.21 | $0.23 |
| .049" | 18 | .17 | .18 | .19 | .20 | .21 | .23 | .25 |
| .065" | 16 | .19 | .20 | .21 | .22 | .23 | .25 | .27 |
| .083" | 14 | .20 | .22 | .23 | .24 | .25 | .27 | .29 |
| .095" | 13 | .21 | .23 | .25 | .26 | .27 | .29 | .31 |
| .109" | 12 | .22 | .24 | .26 | .27 | .28 | .30 | .32 |
| .120" or .125" | 11 | .23 | .25 | .27 | .28 | .29 | .31 | .33 |
| .134" | 10 | .24 | .26 | .28 | .29 | .30 | .32 | .34 |

**MISCELLANEOUS**—Warehouse base prices in cents per lb.:

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Spring steel, light* | 4.50 | 4.65 | 4.65 |
| Spring steel, heavier | 4.00 | 4.00 | 4.00 |
| Coppered Bessemer rods | 6.05 | 6.00 | 6.20 |
| Hoop steel | 4.50‡ | 4.00 | 4.15 |
| Cold rolled strip steel | 6.25 | 6.00 | 6.10 |
| Floor plates | 5.10‡ | 5.30 | 5.00 |
| Cold drawn, round or hexagon† | 3.40 | 3.65 | 3.60 |
| Cold drawn, flat or square† | 3.90 | 4.15 | 4.10 |
| Structural shapes | 3.30‡ | 3.00 | 3.10 |
| Soft steel bars | 3.25‡ | 3.00 | 3.00 |
| Soft steel bar shapes | 3.25‡ | 3.00 | 3.00 |
| Soft steel bands | 4.00‡ | 3.65 | 3.65 |
| Tank plates | 3.30‡ | 3.00 | 3.10 |
| Bar iron (2.75 at mill) | 3.24 | 3.00 | 3.00 |
| Drill rod (from list) | 60% | 55% | 50% |

*Flat, $\frac{3}{16}$@$\frac{1}{2}$-in. thick. †Cold finished steel, shafting and screw stock. ‡250 to 3,999 lb., ordered and released for shipment at one time.

Electric welding wire, New York, $\frac{3}{32}$, 8.35c.; $\frac{1}{8}$, 7.85c.; $\frac{5}{32}$ to $\frac{1}{4}$ 7.35c. per lb.

## METALS

Warehouse Prices in Cents Per Pound for Small Lots:

| | | | |
|---|---|---|---|
| Copper, electrolytic, New York | | | 15.12½ |
| Tin, straits, pigs, New York | | | 53.25 |
| Lead, pigs, E. St. Louis | 5.97½ | New York | 7.00 |
| Zinc, slabs, E. St. Louis | 6.12½ | New York | 7.00 |

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Antimony, slabs | 13.50 | 13.25 | 14.25 |
| Copper sheets, base | 23.25 | 23.00 | 23.00 |
| Copper wire, base | 19.62½ | 19.62½ | 16.00* |
| Copper bars, base | 21.75 | 21.50 | 22.00 |
| Copper tubing, base | 24.75 | 24.50 | 24.50 |
| Brass sheets, high, base | 19.00 | 18.75 | 18.75 |
| Brass tubing, high, base | 23.87½ | 23.62½ | 23.62½ |
| Brass rods, high, base | 16.75 | 16.50 | 16.50 |
| Brass wire, high, base | 19.50 | 19.50 | 19.25 |

*At mill.

# Shop Materials and Supplies

## METALS—Continued

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Aluminum ingots, 99% | 25.00* | 22¾@24 | 24.30 |
| Zinc sheets (casks) | 9½@10 | 10.75 | 9.36 |
| Solder (strictly) | 33.75 | 32.50 | 31@34 |
| Babbitt metal, delivered, New York, cents per lb.: | | | |
| Genuine, highest grade | | | 70.75 |
| Commercial genuine, intermediate grade | | | 53.00 |
| Anti-friction metal, general service | | | 31.50 |
| No. 4 babbitt (f.o.b.) | | | 12.00 |
| Nickel, f.o.b. refinery, Bayonne, N. J., cents per lb.: | | | |
| Ingots 35.00 | Electrolytic 37.00 | Shot | 36.00 |

*Delivered.

**SPECIAL NICKEL AND ALLOYS**—Price in cents per lb., f.o.b. Huntington, W. Va.:

| | |
|---|---|
| Full finished nickel sheet (base) | 52.00 |
| Cold rolled nickel sheet (base) | 60.00 |
| Hot rolled rods, Grade "A" (base) | 45.00 |
| Cold drawn rods, Grade "A" (base) | 53.00 |

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

| | | | |
|---|---|---|---|
| Shot | 28.00 | Hot rolled rods (base) | 35.00 |
| Blocks | 28.00 | Cold drawn rods (base) | 43.00 |
| Cold rolled sheets (base) | 50.00 | Full finished sheets (base) | 42.00 |

**OLD METALS**—Dealers' purchasing prices in cents per pound for carloads, f. o. b.:

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Crucible copper | 12.50 @12.75 | 11.50 | 11.25@11.75 |
| Copper, heavy, and wire | 11.75 @12.50 | 10.75 | 10.75@11.25 |
| Copper, light, and bottoms | 10.50 @11.00 | 9.50 | 9.50@10.00 |
| Heavy lead | 5.00 @ 5.25 | 5.25 | 4.25@ 4.75 |
| Tea lead | 3.75 @ 4.00 | 3.75 | 3.25@ 3.75 |
| Brass, heavy, yellow | 7.25 @ 7.50 | 7.25 | 7.00@ 7.50 |
| Brass, heavy, red | 9.50 @10.00 | 9.75 | 9.00@ 9.25 |
| Brass, light | 5.50 @ 6.00 | 5.75 | 6.00@ 6.50 |
| No. 1 yellow rod turnings | 7.62½@ 8.12½ | 7.50 | 7.25@ 7.75 |
| Zinc | 3.25 @ 3.50 | 3.25 | 2.75@ 3.25 |

**TIN PLATES**—Charcoal—Bright—Per box.

| | | New York | Cleveland | Chicago |
|---|---|---|---|---|
| "AAA" Grade: | | | | |
| IC, | 14x20 | $12.10 | $11.95 | $11.50 |
| "A" Grade: | | | | |
| IC, | 14x20 | 9.70 | 9.90 | 9.50 |
| | Coke Plates—Primes—Per box | | | |
| 100-lb., | 14x20 | 6.45 | 6.10 | 7.00 |
| | Terne Plates—8-lb. Coating—Small lots—Per box | | | |
| IC, | 14x20 | 7.75@8.00 | 7.00 | 7.50 |

## MISCELLANEOUS

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Cotton waste, white, per lb.* | $0.10@0.13½ | $0.16 | $0.15 |
| Cotton waste, colored, per lb.* | .09@ .13 | .12 | .12 |
| Wiping cloths, washed white, per lb | .15½@.17½ | 38.00 per M | .17 |
| Sal soda, per lb | .02 | .02 | .02¾ |
| Roll sulphur, per lb | .027 | .03½ | .04 |
| Linseed oil, raw, per 7½-lb. gal., 1 to 4 bbl lots | 83¼ | 84 | .78 |
| Cutting oil, about 25% lard, in 5 gal. cans, per gal. | .65 | .60 | .60 |
| Machine oil, medium-bodied (55 gal. steel bbl.) per gal | .30 | .36 | .36 |
| Belting—Present discounts from list in fair quantities (½ doz. rolls). | | | |
| Leather—List price, 24c. per lin.ft. per inch of width for single ply | | | |
| Medium grade | 35% | 35% | 35% |
| Heavy grade | 30% | 30% | 30% |
| Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft. | | | |
| First grade | 45% | 50–10% | 50% |
| Second grade | 50% | 60–5% | 50–10% |

*All waste in bale lots.

## *Comparative Warehouse Prices*

| New York | Unit | Current Price | Four Weeks Ago | One Year Ago |
|---|---|---|---|---|
| Soft steel bars | per lb. | $0.0325 | $0.0325 | $0.0324 |
| Cold drawn shafting | per lb. | .034 | .034 | .04 |
| Brass rods | per lb | .1675 | .165 | .1587½ |
| Solder (½ and ½) | per lb | .3375 | .34 | .41 |
| Cotton waste, white | per lb. | .10@.13½ | .10@.13½ | .10@.13½ |
| Emery disks, cloth, No. 1, 6-in. dia | per 100 | 3.10 | 3.10 | 3.10 |
| Lard cutting oil | per gal. | .65 | .65 | .55 |
| Machine oil | per gal. | .30 | .30 | .33 |
| Belting, leather, medium | off list | 35% | 35% | 40–5% |
| Machine bolts, up to 1x30 in., full kegs | off list | 50%* | 50%* | 50%* |

*List prices as of April 1, 1927.

## MISCELLANEOUS—Continued

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Abrasive materials—Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets: | | | |
| *Flint paper | $5.40 | $4.95 | $5.13 |
| *Emery paper | 10.71 | 9.15 | 10.71 |
| †Emery cloth | 27.84 | 27.85 | 27.84 |
| Emery disks, 6 in. dia., No. 1, per 100: | | | |
| Paper | 1.29 | 1.27 | 1.32 |
| Cloth | 3.10 | 3.05 | 3.05 |
| Fire clay, per 100 lb. bag | 1.00 | .75 | .75 |
| Coke, prompt furnace, per net ton | Connellsville, 2.60@2.75 | | |
| Coke, prompt foundry, per net ton | Connellsville, 3.75@4.50 | | |
| White lead, dry or in oil | 100 lb. kegs | New York, 13.25 | |
| Red lead, dry | 100 lb. kegs | New York, 13.25 | |
| Red lead, in oil | 100 lb. kegs | New York, 14.75 | |

*4½ reams and under. †Less than 2 reams.

## SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

| | Full Kegs or Cases |
|---|---|
| Machine bolts, square heads and nuts: | |
| Up to ¾ x 6-in. | 55% |
| Larger up to 1 x 30-in. | 50% |
| 1¼ and 1¼ in. dia. | 35% |
| Carriage bolts: | |
| Up to ½ x 6-in. | 55% |
| Larger sizes | 50% |
| Coach and lag screws: | |
| Up to ½ x 6-in. | 55% |
| Larger sizes | 50% |
| Tap bolts, hexagonal heads | 40% |
| Nuts: | |
| Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl. | 55% |
| Cold punched, square and hexagonal, blank or tapped, up to 1-in. incl. | 55% |
| Semi-finished, hexagonal, tapped, in packages, all sizes | 40% |
| Case hardened, hexagonal, tapped, in packages, all sizes | 30% |
| Washers: Deduct from list, per 100 lb | $3.50* |
| Rivets, button and cone head: | |
| Small, including ⅜-in dia | 50–10% |
| Large (base) per 100 lb. net | $5.00† |

Note—For less than case or keg quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.
*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

# Machine Requirements and Industrial Construction

## Equipment Wanted

**Md., Baltimore** — Bd. of Awards, City Hall, will receive bids until June 6, for machinery, equipment, tools and supplies for general shops for Bd. of School Commissioners.

**Mich., Detroit**—Enterprise Tool Co., 1590 East Philadelphia Ave.—universal milling machine.

**Mich., Detroit**—Ex-Cell-O Tool & Mfg. Co., 1469 East Grand Blvd., miscellaneous machine shop equipment for proposed 2 story, 135 x 188 ft. factory on Oakman Blvd. Estimated cost $75,000.

**Mo., St. Louis** — Missouri-Kansas-Texas Railway, Railway Exchange Bldg., G. E. Scott, Purch. Agt.—90 in. lathe for journal turning and quartering and crank pin turning.

**O., Columbus** — H. Clapham and D. O. Miller, c/o Central Machine & Tool Co., 208 East Rich St.—additional machinery and equipment for recently acquired plant.

**O., Columbus** — Good Roads Machinery Co., 165½ North High St., P. C. Converse, Mgr.—power press, large size.

**O., Columbus** — Ramey Manufacturing Co., 143 North Fifth St. L. S. McKnight, Pres. and Gen. Mgr. (furnaces, vacuum cleaners and blowers)—two forming machines and two slitting power shears, large size.

**O., East Columbus**—Ralston Steel Car Co., J. A. Frank, Purch. Agt.—two drill presses and one automatic screw machine.

**Okla., Frederick** — Frederick Construction Co., A. H. Krause, Pres. (paving contractors)—power crane, 1 cu.yd. capacity.

**Ore., Klamath Falls**—Weyerhaeuser Lumber Co., Tacoma, Wash., G. S. Long, Gen. Mgr.—machinery and equipment for proposed sawmill 275,000 ft. in each 8 hr. shift to include four band saw units for pine, rotary unit for fir and spruce, dry kilns, planing mills, box factory and cut-up plant.

**Pa., Philadelphia**—Dept. of City Transit, 11th floor, 1211 Chestnut St., C. Meyers, Dir., Cont. 176—will receive bids until June 5, for one 13 in. tool room lathe, one 14, one 18 and one 20 in. engine room lathes, one 24 in. engine room lathe, swing 6 in. between centers, one 24 in. engine room lathe, swing 8 in. between centers, one 24 in. pattern makers' lathe, one 2 in. single head bolt threading machine, two pipe threading and cutting machines, one oil stove tool grinder, one carpenters bench, one pattern makers' bench, one 16 in. joiner, one 36 in. band saw, one 16 in. circ. cut-off saw and one shaftless variety saw.

**Tex., Beaumont** — Beaumont Import & Export Co., c/o J. W. O'Shaughnessy, Mgr. —machinery and equipment including rip saws, planers, etc. for proposed lumber mill. Estimated cost $80,000.

**Ont., Elmira**—Link Belt Ltd., H. Vice, Mgr.—additional equipment including electric crane, etc. for proposed 25 x 100 ft. addition to foundry. Estimated cost $30,000.

**Ont., Windsor**—Canadian Engineering & Tool Co., 10 Church St., J. P. McConnell, Mgr.—machinery and equipment for the manufacture of engineering equipment and tools for proposed 1 story, 50 x 156 ft. factory on Huron St. Estimated cost $25,000.

## Opportunities for Future Business

**Calif., Los Angeles** — Willys-Overland Co., represented by J. A. Sheldon, Biltmore Hotel, will soon receive bids for a 220 x 880 ft. assembly plant at Laguna-Maywood Tract.

**Conn., New Haven**—Western Electric Co., 80 John St., awarded contract for a 2 story factory. Estimated cost $50,000.

**Ill., Chicago** — F. W. Gould Corp., 868 North Clark St., plans the construction of a 2 story, 112 x 152 ft. garage at 856-70 North Clark St. Estimated cost $80,000.

**Ill., Chicago**—Huguelet Bros., 911 Ernst Ct., awarded contract for a 4 story, 50 x 200 ft. garage at 915-17 Ernst Ct. Estimated cost $150,000.

**Ill., Joliet**—Illinois Steel Co. plans the construction of a plant, etc., here. Estimated cost $250,000.

**Ia., Marshalltown** — Cooper Mfg. Co., manufacturers of auto heaters, is having plans prepared for a 2 story, 50 x 150 ft. factory. Estimated cost $50,000.

**Ia., Waterloo**—John Deere Tractor Co., is having plans prepared for 6 story factory. Estimated cost $150,000.

**Md., Baltimore** — Union Bros., 37 West Cross St., manufacturers of furniture, plans the construction of a 1 story factory at Beason, Decatur, Clement and Lowman Sts. Estimated cost $75,000. B. Frank, 517 North Charles St., Archt.

**Mass., Attleboro**—L. G. Balfour & Co., 25 County St., manufacturing jewelers, is having plans prepared for a 2 story addition to factory. F. B. Perry, 44 Franklin St., Providence, R. I., Archt.

**Mass., Boston** — H. Raeder, 20 West Jackson Blvd., Chicago, Ill., Archt., will soon award contract for a 2 story addition to garage here.

**Mass., Cambridge** (Boston P. O.)—Barbour-Stockwell Co., 205 Broadway, awarded contract for a 1 story brass foundry at Broadway and Market Sts.

**Mass., Chelsea** (Boston P. O.)—Standard Box Co., 28 Gerrish Ave., awarded contract for a 2 story, 100 x 140 ft. addition to factory. Estimated cost $75,000. Noted Jan. 12.

**Mass., Gardner** — Hedstrom Union Co., 319 Main St., manufacturers of baby carriages, is receiving bids for a 3 and 4 story, 60 x 130 ft. and 40 x 60 ft. factory. Estimated cost $125,000. G. A. Johnson, 16 Norwich St., Worcester, Archt.

**Mass., Methuen** (Lawrence P. O.)—W. Sutton, 2 Oakland Ave., awarded contract for a 1 story repair shop and service station on Oakland Ave. Estimated cost $40,000.

**Mass., New Bedford**—Commission of City Property, City Hall, is receiving bids for a 2 story vocational school including machine and electric shops, etc. on Park St. C. Hammond & Son, 179 North Water St., Archts.

**Neb., Omaha** — A. Beck, Keeline Bldg., will build a 3 story, 67 x 120 ft. garage at 18th and Dodge Sts. Estimated cost $90,000. J. T. Allen and N. S. Wallace, 224 Brandeis Theatre, Archts.

**Neb., Omaha**—E. R. Porter, 324 Brandeis Theatre Bldg., is having plans prepared for a 146 x 198 ft. garage at 20th and Dodge Sts. Estimated cost $150,000. H. C. Peterson, 425 Bankers Reserve Bldg., Archt.

**N. J., West New York** — Public Service Electric & Gas Co., 80 Park Pl., Newark, is having plans prepared for a 2 story, 60 x 200 ft. distribution plant including garage, etc. at 12th and Jefferson Sts., here. Estimated cost $200,000. Public Service Production Co., 80 Park Pl., Newark, Archt.

**N. Y., Brooklyn**—Levine & Witkin, 11 West 42nd St., New York, had plans prepared for a 2 story, 80 x 83 ft. garage, etc. at Atlantic Ave. and Utica St. here. Estimated cost $55,000. M. Klein, 65 Court St., Archt.

**N. Y., Corona** (Flushing P. O.)—Philbin Realty Co., Bank of Manhattan Bldg., Long Island City, will receive bids about July 1, for a 2 story, 115 x 150 ft. garage at Junction Blvd. and 37th Ave., here. Estimated cost $50,000. W. Shary, 41 Union Sq., New York, N. Y., Archt. Noted May 3.

**N. Y., Larchmont** — E. H. Faile & Co., 441 Lexington Ave., New York, Archts., will receive bids until June 15, for a 3 story garage at North and West Sts. here, for J. A. Isbister, Cleatsworth Ave. Estimated cost $50,000.

**N. Y., New York**—E. Franck, 80 Maiden Lane, awarded contract for a 5 story, 68 x 100 ft. garage and storage warehouse at 400 East 59th St. Estimated cost $200,000.

**N. Y., New York**—Gilsam Realty Corp., A. Tannabaum, Pres., 50 East 42nd St., had plans prepared for a 2 story, 100 x 100 ft. garage at Sedgwick and Undercliff Aves. Estimated cost $45,000. C. Schaefer, Jr., 332 East 149th St., Archt.

**N. Y., New York** — Hyleo Realty Corp., H. Friedman, Pres., 391 East 149th St., will build a 1 story, 103 x 107 ft. garage at White Plains Rd. and Bronxdale Ave. Estimated cost $51,000. Cohen & Siegel, 45 West 57th St., archts.

**N. Y., New York**—J. P. E. Realty Corp., J. P. Carey, Pres., Grand Central Terminal Bldg., had plans prepared for a 2 story, 75 x 200 ft. garage at 338 East 48th St. Estimated cost $90,000. A. J. Thomas, 2 West 46th St., Archt.

**N. Y., New York**—Nestha Realty Corp., M. D. Strong, Pres., 2020 Jerome Ave., had plans prepared for a 2 story, 100 x 100 ft. garage at White Plains and Bronxdale Aves. Estimated cost $40,000. W. Shary, 41 Union Sq., Archt.

**N. Y., New York** — Sanka Construction Corp., S. Katz, Pres., 391 East 149th St., will build a 1 story, 103 x 147 ft. garage at White Plains Rd. and Bronxdale Ave. Estimated cost $60,000. Cohen & Siegel, 45 West 57th St., Archts.

**N. Y., New York**—L. Silver Co. Inc., L. Silver, Pres., 391 East 149th St., will build a 1 story, 100 x 125 ft. garage at Bronxdale and White Plains Aves. Estimated cost $45,000. Cohen & Siegel, 45 West 57th St., Archts.

**O., Akron**—Akron Lamp Co., 600 South High St., plans the construction of a 2 story, 60 x 70 ft. factory. Estimated cost $40,000.

**O., Springfield** — Springfield Metallic Casket Co., will soon receive bids for the construction of a 5 story addition to factory. Estimated cost $100,000.

**Pa., Philadelphia**—C. Kahn, Morris Bldg., awarded contract for a 2 story, 70 x 131 ft. sales and service station at 56th and Chestnut Sts. Estimated cost $150,000. Sentman Motor Co., lessee. Noted May 17.

**Pa., Philadelphia** — J. C. Kahn, Morris Bldg., awarded contract for a 2 story, 60 x 277 ft. factory at Westmoreland and Stokely Sts. Welsbach Street Lighting Co., 20th and Arch Sts., lessee. Noted May 10.

**Pa., Philadelphia**—Proctor & Schwartz, 7th and Tabor Sts., manufacturers of machinery, will soon award contract for a 2 story, 50 x 145 ft. addition to factory. Day & Zimmerman, 1600 Walnut St., Engrs.

**Pa., Pittsburgh** — Heppenstall Forge & Knife Co., 4620 Hatfield St., awarded contract for a 1 story addition to plant. Estimated cost $40,000.

**R. I., Auburn** — Kenney Mfg. Co., 609 Wellington Ave., manufacturers of curtain rods, awarded contract for a 1 story, 60 x 160 ft. addition to factory. Estimated cost $40,000.

**R. I., Providence** — W. E. Louttit, 93 Cranston St., awarded contract for a 1 story garage and repair shop. Estimated cost $100,000.

**Texas**—Ewauna Box Factory, Klamath Falls, Ore., is having tentative plans prepared for the construction of four warehouses at Weslaco, Brownsville, San Benito and Harlingen, here.

**Tex., Beaumont** — W. W. Kyle, Kyle Bldg., is receiving bids for a 4 story, 60 x 150 ft. garage at Main and Crockett Sts. Estimated cost $50,000. F. W. Steinman & Son, 410 San Jacinto Life Bldg., Archts.